Environmental Issues - A Special Reference to Bangalore's Lakes and Solid Waste Management

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BACKGROUND MATERIAL

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INTRODUCTION

Bangalore, the 'Garden City' is situated in the centre of the tableland of Mysore. The City which is endowed with a salubrious climate, is at an altitude of 3000ft above the mean sea level. It is called the 'Garden City' because its natural beauty is preserved in its numerous parks, gardens and boulevards. Nature has aided Bangalore greatly with two of its important elements viz., fertile soil and abundant rainfall, which have made it an abode of a variety of flowers and plants. The only natural disadvantage from which Bangalore suffers is the absence of a river in its proximity.

Bangalore is not an old or traditional settlement. It is not an ancient capital; it has no port. Yet, in spite of not having these traditional city founding characteristics, Bangalore today ranks fifth as a commercial metropolis in India. Bangalore accounts for approximately 25% of the urban population of Karnataka. Its primary index is four times that of the next biggest city, Hubli-Dharwad.

Bangalore is one of the fastest growing cities in the country which experienced tremendous growth during 1970s. The population of the city currently at 4.5 million according 1990 census is well poised to exceed 7 million mark by 2011. While urbanization is inevitable and cannot be stopped, our endeavor should be to ensure that it takes place on an orderly and systematic basis. Out of the total urban population of 13.8 million in the State of Karnataka, Bangalore accounts for 29.5 percent of it. The ever increasing population would add more problem to the already strained infrastructure facilities, like water supply, under ground drainage, shelter, electricity, transportation, etc., unless timely action is taken to resolve them.

Our garden city is fast becoming a living hell. The vehicle boom has spelt doom for the city. Increasing number of vehicles has in turn led to a rise in the incidence of respiratory diseases and complaints of allergy in Bangalore. Being one of the fastest growing cities in country, Bangalore is naturally susceptible to increasing air and noise pollution. There are nearly one million vehicles in the city. Environmentalists warn that Bangalore is headed for disaster unless steps are taken to bring down vehicular pollution and clean the city.

In most Indian cities, air pollution has worsened in pockets, due to traffic congestion, poor housing, poor sanitation and drainage and garbage accumulation. As levels of aldehyde, ozone and several chemicals are not being monitored; we cannot correlate, for instance, smog with some parameters.

While it is not possible to reverse the growth of cities, emissions from factories and vehicles should be brought down if we want to control the effect of air pollution on health. The phenomenal increase in population, the outward sprawl of the city and high concentration of economic activities have contributed to a spurt in the vehicular population. Over the last 25 years air pollution has worsened due to increased Nitrogen dioxide (NO_2) and carbon monoxide (CO) emissions. Suspended particulate matter

(SPM) levels have increased slightly while sulphur dioxide (SO_2) levels have declined. The latter is attributed to a lower use of coal and high sulphur fuel.

Come summer and Bangalore plays host to a number of water-borne diseases. The contamination of water, accumulation of garbage, flow of untreated sewage into lakes and tanks and water stagnation, all make Bangalore susceptible to the outbreak of water-borne diseases.

Lakes and tanks of Bangalore have been subjected to environmental degradation. These natural resources have become dumping grounds for solid waste, raw sewage, industrial effluents, etc. In Bangalore and its environs, over three hundred and thirty species of birds have been recorded so far. Wetland and water birds account for more than forty percent of this total. There is great opportunity to improve existing water bird habitats within the city and conservation of these wetland sites as wildlife habitats is a grave necessity today.

Bangalore today is facing the herculean task of garbage disposal as it generates over 2500 tonnes of garbage everyday. Several hospitals and clinics in the city dump their waste, classified as hazardous, in municipal bins and garbage chutes. There is an immediate need to take action for identification and development of scientifically design suitable sanitary landfill sites. National Institute for Communicable Diseases (NICD) has identified Bangalore one of the "foci" for intensified plague surveillance. While advanced countries have controlled epidemics through adequate public health measures, developing countries have ignored this aspect consistently.

Though there are many private, NGO and CBO initiated projects taking care of the segregation, collection, transportation and disposal (by composting) aspects of solid waste in many areas of Bangalore, it certainly needs an efficient umbrella system, that looks after the whole solid waste management aspect.

Water supply forms an important lifeline in any urban environment. All our activities come to a standstill, if water is not available. Whereas one can live with reduced comforts as far as other basic requirements like shelter, education, transport, energy, etc. are concerned, one cannot find life easy if water is not available to meet basic needs. Bangalore is one of the few cities in the world which is too far from a perennial source of water and is located at such an altitude that every drop of water has to be pumped over high heads. The rapid growth in population and the absence of a nearby and dependable source has created wide gaps in supply and demand. Drinking water quality in many areas is found to be below potability standards. Also, ground water sources in many areas are chemically and biologically contaminated.

Bangalore gets its water supply from two sources. Bangalore South is supplied from Cauvery river whereas Bangalore North gets its supply from T.G. Halli reservoir built across river Arkavathi. Recently, Delhi based M/s DLF Ltd. has been permitted to construct 270 villas on the foreshores of river Arkavathi near the T.G. Halli lake which supplies drinking water to ¼ of Bangaloreans. These villas, as and when constructed are

bound to pollute the reservoir and destroy a major lifeline of Bangaloreans. In this regard, the Bangaloreans are voicing a strong protest against the jeopardous project.

Slums are the byproducts of the process of urbanization. Urbanization at an accelerated phase has worsened the conditions of slums, illegal squatter colonies and poorly serviced tenement houses. There are 430 slums in the city with approximately 15% to 20% people living under deprivation and exploitation.
Increasing growth of industries along with consequent unplanned growth of housing colonies not commensurate with the potential of water supply and sewerage are becoming a major concern for not only the policy makers but, to the common man also.

Bangalore, once known as the 'Garden City' is fast losing its greenery. The two most prized possessions of Bangalore, viz., Lal Bagh and Cubbon Park, are threatened by encroachment. Recently, a part of the Cubbon Park was denotified for construction of Legislators Home which received an enormous amount of public concern and especially women's groups took a lot of initiative in protesting against such an act which would eventually devastate the greenery of the Bangalore.

It should be seriously noted that the consumption of energy in the last century is about half the total energy used by human beings over millions of years. This can be attributed to the industrial revolution, modernisation and urbanisation. According to a 1991 data, every year Bangalore requires about 160 thousand kilo litres of kerosene, 90 thousand kilo litres of petrol, 350 thousand kilo litres of diesel and 2000 million kilo watts/hour electricity. It is believed that Bangalore would witness a large scale increase in the demand for fuel wood by the year 2000. It needs about 5 lakh tons of fuel wood every year which means we are cutting about 10 ha of forest; also the transportation of the fuel wood consumes large quantities diesel and petrol that in turn affects our country's foreign exchange.

Hence, these and several other burning environmental issues have to be addressed as early as possible to avert a catastrophe, looming large over Bangalore City.

STATUS OF LAKES IN BANGALORE

STATUS OF LAKES IN BANGALORE

1. INTRODUCTION

Tanks and lakes have played an important role in the water history of Karnataka. As a major part of Karnataka is in the rain shadow region of the Deccan Plateau, tanks and lakes were the primary sources of drinking water and irrigation. Most of these tanks were built in the pre-British days. A linked chain of such tanks was created in each region. Situated in the same catchment area, the surplus water from one tank would flow into another situated below or at a lower level.

Bangalore has the dubious distinction of being the fastest growing city in India. It had a population of about four million in 1985 and this figure is estimated to cross seven million by the turn of this century, with an annual rate of increase estimated to be 5.5 percent. On the physical side, from around 67 sq. km in 1961, it has expanded by over six times. This explosive increase in extent has put a lot of pressure on land. The number of man-made lakes has fallen from 262 in 1960 (in the existing Corporation and Bangalore Development Authority area), to 81 lakes today. This clearly highlights the threat faced by the lakes and the immediate conservation measures needed for saving them.

The Bangalore area is quite undulating and consists of low hills and valleys, which have elevations ranging from 850m to around 930m above MSL. The topography of Bangalore has uniquely supported the creation of a large number of man made lakes. These lakes form chains, being a series of reservoirs across streams. These streams tend to take water down and away from the Bangalore plateau and all the water in Bangalore therefore naturally flows out, but never flows in. In the absence of a system of impoundment whereby this runoff water is left untrapped and ground water aquifers not recharged, the scenario would indeed become very bleak and scary.

Of the 127 tanks in Bangalore City in 1980s, 46 are classified as defunct. A systematic survey of Bangalore's tanks was first made in 1985 under the chairmanship of N. Laxman Rau. As recommended by Laxman Rau Committee, the 'live' tanks were handed over to the Forest Department in 1988

2. HISTORICAL BACKGROUND

Bangalore was founded in 1537 as a Pettah town, by Magadi Kempegowda-I, from what must have been a dry deciduous forest area. Lakes have played a very important role in the life of the City of Bangalore since time immemorial. Unlike most other cities, Bangalore is not blessed with a perennial river and this might have been the reason why the founder established many lakes across seasonal streams. Recent history reveals that some of the lakes have been formed into residential localities, or have slums developing in them. Some have been used by the State for public purposes like bus stands and stadiums. There are instances in the recent past that some of the lake beds have fallen into hands of land grabbers.

3. ROLE OF LAKES IN BANGALORE

The establishment of these lakes initially served as a source of water for agriculture, drinking and washing. As they aged over the years, they turned into lentic-closed aquatic habitats and attained an important ecological status. In the Bangalore area (not just the city), just 4.0 % of the land is covered by water. Despite this, over 40% of the bird species, for example, to be found in the area are from wetlands.

♦ Socio-Economic role

Lakes in the area were established primarily for two important purposes. Obviously, the primary purpose was for domestic and agricultural needs of the village population living around the newly founded pettah town. These lakes enabled the growing and supply of food grains and vegetables to the town population, apart from meeting their own requirements. In the latter part of the last century, urban growth forced the administration to draw water from the lakes for urban water supply. The process of urban water supply to the growing city led to the creation of a few more lakes, exclusively for the purpose (Hasan, 1970). The advent of long distance pumping and water supply has led to an utter apathy being shown towards the lakes, virtually converting them into sewage settling ponds, forgetting that they were once a source of drinking water. Industrialization, during the middle of this century, saw the surviving lakes providing water for industrial uses. But the recent spurt of commercial activities including industrialization has engulfed many lakes.

♦ Hydrological role

These lakes have an important role in the recharge of ground water. The capability of these lakes to trap and store rainwater, with a good system of storm-water drains, is some thing enormous. Just taking the lease annual rainfall that Bangalore has ever received, the total rainwater that could be harvested would amount to about one third of the demand. This collected rainwater even has the potential to be used for the best possible purpose society can think of, that is, drinking.

4. LAKE CONSERVATION PROBLEMS IN BANGALORE

Water goes to form the ecological 'blood stream'. Lakes and wetlands which are characterized by standing water are more vulnerable to accidental and intentional human interference than any other habitat. Imbalanced water flow, eutrophication through sewage or leached fertilizers, industrial effluents or toxic substances, all with or without synergistic effects, can impose very severe constraints on these lakes as good habitats. Added to these are problems caused by biological amplification and those caused through wrong priorities and change in land use. The degree of degradation and loss of lake capacity depends on the extent of human interference in the catchment.

♦ Pollution of lakes

Pollution is killing the tanks, with storm drains carrying sewage into them instead of water. The Domlur tank was polluted by a sewage canal as early as 1875. According to Ghosal, there are three major valleys in Bangalore where sewage is dumped after treatment – the Challaghatta valley, Hebbal valley and Vrishabhavathi valley However, given the undulating surface of Bangalore City, there are several smaller valleys where several tanks are located. Due to faulty planning, small underground sewage systems are not connected to the larger sewers, which drain into these large valleys, and sewage goes into the tanks instead

Groundwater sources have depleted so rapidly that today one has to dig down to 300 m to reach water. Besides, the drying up of the lakes have thrown the lives of the fisherfolk and the washerfolk dependent on them for their livelihoods out of gear. Fish yields have come down drastically.

♦ Eutrophication and loss of water quality

Eutrophication could occur by nutrients from both point and diffuse sources of sewage and sullage. This alters the status of the lake The enormous quantities of nutrients being brought into the lakes makes the water turn green due to the unchecked growth of algae. BOD levels are raised and situations where bad odours emanate from the lake waters are frequent. Increase in BOD and COD levels, organic and inorganic toxins, heavy metals, and increased salinity can all be expected through the diversion or leakage of untreated sewage and sullage into the lakes. The city lakes are fed right through the year by sewage or sullage waters in addition to the rain and hardly ever go dry.

♦ Encroachment of lake beds

Reclamation of the lake beds for uses detrimental to the well being of the lake could very well be termed encroachments. Encroachments are basically for the purposes of human settlements and road buildings. Encroachments not only affect the lake directly, but also bring other disturbances closer to the lake. The shore and vegetation along the lake edge are destroyed, and open opportunities for effluents, raw sewage and sullage to be let into

- **Ecological role**

From the ecological point of view, the lakes form a unique and irreplaceable system. A man made lake of our parts can be viewed as a basin with several zones of water of varying depths, abutting a deeper zone that lies towards the bund. This zonation is dynamic and promotes the growth of a variety of emergent, floating, anchored floating and submerged vegetation, each of which shows a preference to a particular range of water depth. Again, because of the differences in growth habits and structure of these plants, vertically stratified vegetation layers result. These fresh-water plant communities accommodate a large number of small organisms, like periphyton, insects, molluscs, etc. which form the staple diet of many species of invertebrates and vertebrates in the food chain.

Food chains in these lakes can often be complex. The system is more or less a closed one, where everything is consumed and reused and the balance between the various forms of life is very sensitive to change. Light, temperature and the availability of oxygen and nutrients govern the growth of plants of which the smallest and simplest are phytoplankton, which in turn are devoured by zooplankton, insect larvae and fish fry. There are even some adult planktivorous fish and birds (like ducks).

Even the lake sediments support a large variety of soil invertebrates, which thrive on organic matter from decaying plants and animals. These invertebrates are in turn eaten by a variety of other higher organisms. Thus, the food chain lengthens and branches, involving many plants and animal species, and at the very end of this food web is man himself.

- **Environmental role**

The role played by these lakes in making Bangalore, an air-conditioned city cannot be under estimated. It is on account of these lakes that there was thick vegetation and the amount of water transpired from each tree added to the quantity of moisture into atmosphere and thus, increase the relative humidity in the atmosphere. Further, direct evaporation from the water bodies ameliorates harsh conditions. The presence of water bodies has encouraged lot of vegetation around them and all along the streams.

- **Educational and recreational role**

The residents of Bangalore have for centuries enjoyed the scenic beauty around many of the lakes. Many of the smaller lakes hold great potential for the development of recreational facilities like boating. The larger lakes attract a good variety and population of birds, which could effectively be used for instructional, educational and research purposes.

the lake directly. The loss in the number of lakes due to reclamation and conversion has already been referred to in the beginning.

- **Landfilling and garbage dumping**

Landfilling even in a portion of a lake can lead to sever silting in the rest of the lake bed. This can seriously affect the ground water recharge through lakes, since both percolation rate and retention time are drastically affected. Indiscriminate dumping of garbage, other solid waste materials and construction rubble have added to the pollution and siltation problems in the lakes.

Other problems associated with the lakes are –

- Mushrooming of unplanned dhobi ghats leading to increased salinity and contamination from detergents.
- Poaching of protected species of birds and other animals.
- Vehicle washing leading to presence of detergents and washed out hydrocarbons.
- Cattle washing and resultant problems.
- Defeacation at the edge of the water and in the lake beds.
- Over fishing: Disturbance caused by the use of dragnets to the bottom sediments causes the sudden release of trapped nutrients into the lake waters, leading to algal blooms.
- Consumption of fish grown in contaminated lake waters and effluents poses serious health hazards.
- Boating and other recreational activities disturb the natural ecosystem.

5. CONSERVATION OF LAKES IN BANGALORE - THE TRACK RECORD

The state government in 1985, set up the N Laxman Rau Committee to assess the status of man made lakes in the urban and green belt area of Bangalore. This Committee did a rapid survey and listed the general status of the existing lakes and problems they faced. In the first meeting of the Committee, it was resolved that pending final recommendations, the Government should be addressed to issue necessary instructions to the authorities concerned on the following lines:

- No layout should be allowed to be formed in tank bed areas either by the Bangalore Development Authority or by any other body;
- Water sheets should be maintained wherever it is possible and sewage and other pollutants should be suitably diverted;
- The dried tank beds should be utilized to develop Tree Parks;
- In live tanks, off shore planting between full tank level and maximum water level contour area should be undertaken;
- Bangalore Development Authority should not take up formation of sites in tank beds as in Sinivagilu tank bed;

- ❖ Pending final report, Government should be addressed that the tank beds should be utilized only for parks, regional parks, tree parks, picnic spots and as water sheets and on no account the tank beds be allowed to be used for any other purpose.

The Committee is happy that Government took action promptly and issued necessary directions to the authorities. The committee made a very positive contribution by recommending handing over of these lakes to the custody of the State Forest Department for protection and for foreshore afforestation. The Committee report gave a great impetus for lake conservation efforts in Bangalore.

In spite of the existing regulations it has very difficult to protect city lakes from being destroyed. It is inevitable to have a strong legislation to conserve them for posterity. Some of the lakes in Bangalore have found mention as potential sites of international importance under the Ramsar Convention of the United Nations. It is high time that these water bodies are declared as sanctuaries. In conclusion, it can be very easily said that the lakes in the area have no substitute. They are either saved with the concurrent benefits or they are lost forever, with human kind being poorer of it in either the proximal or longer run.

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WATERSHED MANAGEMENT

WATERSHED DEVELOPMENT

Eco-power

D. Banerji

Environment restoration is more than planting saplings and checking erosion, it can change people's lives. C. **Rammanohar Reddy** describes one such outcome in a village in Madhya Pradesh.

LESS than five years ago, frequent brawls, a high incidence of alcoholism and astronomical levels of indebtedness were common in Neemkheda, a remote village in Dewas district of Madhya Pradesh.

Today, things are different. There are fewer fights, the brewing of illicit liquor has come down and the burden of debts too has begun to lighten. The most noticeable change is that the youth of Neemkheda, who earlier either migrated to Indore (50km away) or lived on the edge at home, now have a sense of purpose which shows on their faces.

This change in Neemkheda is not the result of any social reform movement in the area. Nor has it followed political mobilisation as is commonly understood.

The new assertiveness in Neemkheda is the product of as mundane a programme as environmental regeneration. For the young men of the village, bunding fields, excavating farm ponds, planting saplings and building underground dykes are far from routine activities. This work of environmental regeneration is something they have control over, the results of which are there to see and which they have fought to preserve.

These are important things for people accustomed to everyday extortion by officials, public funds that disappear before they reach the approach road to the village and a general apathy at all levels of government.

Of course, much of the change is the result of the intervention of a non-government organisation, the Samaj Pragati Sahyog (SPS), which has been working in the area since 1993. Yet, the transformation amongst the youth of Neemkheda is hardly an example of an outside agency handing out plans and funds to create assets and generate employment. In a sense, it is Neemkheda rather than SPS which now "owns" the ongoing environment restoration programmes. The process has taken a couple of years and it has been the fall-out of having to fight to retain control of one's environment.

How it started

The story begins in late 1993, when SPS made the first attempts to repair the ravages of government indifference in the area. With funds from State and Central Government agencies, a number of watershed development activities were taken up in this village of about 110 tribal households with a population of around 900.

In this largely agricultural village which had little land under irrigation, the SPS proposed, visualised and oversaw a number of activities. Over the past three years, nearly 95 per cent of land in the village has been bunded to prevent soil erosion. Farm ponds have been built to store water for a second crop. And in the *nullah* that flows through the village, underground dykes have been built to raise the water level in nearby wells. Experiments have been conducted to raise agricultural yields and control use of chemical fertilizers and pesticides.

In the short-term, much of this work had the usual impact on employment and incomes. Work

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A Neemkheda farm pond filled to the brim (inset: construction of the farm pond in progress)

was available in the lean season where earlier there was little to do. Unlike in the government-sponsored activities, those who participated in the programmes received a minimum wage. And even more unbelievable, women earned the same wage as men.

On the environment side, soil erosion appears to have largely ended, water tables seem to have risen and there is more greenery around than three years ago.

These, however, are "conventional" outcomes. More important were the struggles within the village and outside that participants in the environment regeneration programme have had to carry out to safeguard the fruits of their work.

First sign of trouble

Neemkheda has no landlords. There are no outside interests either that explicitly hold down the people of the village. But like much of Indian society it has its divisions and conflicting economic interests.

The first sign of trouble showed up in early 1996. The dykes that had been built would keep water in the *nullah* for a longer time and help families downstream irrigate their lands. But this would be possible only if those upstream did not overexploit the water by building underwater channels that emptied the *nullah* in no time. Though a community agreement was forged to let the dykes function, it required only one farmer to break it.

Majid Khan, accustomed to years of helping himself to the water of the *nullah,* decided to violate the pledge. Attempts at persuasion were followed by dharnas, all to little avail. "The village asked Majid Khan to stop taking water, and when he refused we forced him to close the channel," said Kamal, one of the many youth of Neemkheda who are proud of the restoration of their village's environment.

However, Majid Khan did not stop there. He went to court to open up his water channel. But the judgment went in favour of the larger community and that irrigation channel has now been permanently blocked. More than the judgment, what the *nullah* dispute showed – for the first time in decades – was that it was possible to take control and defend the community's natural resources against individual interests.

More trouble was, however, brewing. Some members of the zilla parishad and other elected members of local bodies were not too pleased with power slipping out of their hands. Many fuses were lit, the biggest one was in August 1996 over an afforestation project.

During the 1996 monsoon, the villagers of

"Earlier whenever someone in the village had a problem, he was on his own. Now there are ten people to help for every person facing difficulties."

Neemkheda decided to restore forest cover on a denuded patch of 200 hectares that overlooked the village. Neem, acacia, bamboo and tamarind were some of the species planted. The problem was that cattle too needed to be grazed. And these were cattle were from Neemkheda as well as a neighbouring village.

Elaborate rules were drawn up for protection of the fledgling forest. The entire tract would be covered with saplings over three years, with a third of the area planted every year. While afforestation was going on, grass from the area would be made available. After three years, when the saplings would have grown to a reasonable height, grazing too would be allowed. And the villagers would take turns to protect their prized plantation.

It does not take much though to strike at a nascent experiment. In an area where it is difficult to find feed for cattle, those who wanted to destroy the afforestation experiment found it easy to whip up fears about denial of access to the forests.

Village divided

In no time violence erupted, the village was divided, neighbouring villages joined in and at the end of it all more than half the saplings on a 60 hectare patch had been destroyed. Disappointment is written all over Gendhalal's face as he talks about the saplings that were uprooted. But he and his friends are determined to repeat their efforts after the monsoon of 1997.

The first experiment at afforestation may have partly foundered in terms of the number of saplings that have survived. But when judged in terms of what it did for the young people of Neemkheda the outcome has been the opposite.

People's pride

Here was something belonging to the community as a whole and not to an individual, which they fought for. Here was something that united them against petty officials and callous policemen (who were blatantly partial in their intervention). And here, most important, was something on which they, rather than SPS, were taking the decisions.

Laxman, another young participant, talks of "a yudh" that needs to be fought to protect the environment against selfish interests. Kamal puts the same thing differently, "Earlier whenever someone in the village had a problem, he was on his own. Now there are ten people to help for every person facing difficulties."

The most visible sign of the villagers themselves taking charge of the environment programmes and of community concerns underlying the administration of these activities is to be had in the working of the village "watershed committee."

This committee receives funds from the State Government for construction and maintenance of assets that have been created in the watershed. Comprising 20 members it has been in operation now for more than a year.

Members of the committee have already acquired the expertise to measure, cost and oversee all envi-

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Discussing the afforestation programme

D. Banerji

Women learning to repair handpumps

ronment-related activities: contour bunding of fields, excavation of farm ponds, construction of gabian structures in the rivulets, etc. It is this committee rather than any local government official which decides what "works" (the language of the civil contractor has entered the villagers' vocabulary) should be taken up. It meets twice a month to evaluate farmers' requests for creation of assets on or near their fields. And the go-ahead is given only after the committee as a whole has decided that the requests are legitimate. And half-a-day of *shramdan* by all members is a core element of the committee's bimonthly meetings.

Criterion for job

More interesting is how villagers are chosen for employment on any construction or maintenance activity. If there are sufficient funds and the programmes are large, there is no problem. All those seeking work will find employment. But if that is not the case, the committee has prioritised selection of workers.

First, men and women from landless families will be offered daily employment, with one person drawn from each family. If there is more to be done, people owning unirrigated land are given second preference. After this, third, paid employment will be offered to members of all families. Even here the proviso is that at least one person from each household should first get employment. And in case it is possible to yet employ more people, then all those in the village who want to work can participate in the watershed programmes.

Equity concerns

If a strong concern for equity and the needs of the especially disadvantaged underlie such rules of selection, a more assertive intervention characterise other activities. Today, all villagers attend the Gram Sabha meetings and express what they feel, particularly when it comes to the environment programmes. No longer are decisions taken at the Gram Sabha meetings by the village elders and the more powerful members of the community.

The pride of Neemkheda now is an institute of watershed development that is coming up at one end of the village. Funded by CAPART and facilitated by the Samaj Pragati Sahyog, the Baba Amte Lok Sashaktikaran Kendra, will train villagers from all over Madhya Pradesh in various aspects of watershed management.

Less than five years ago, Laxman, Kamal, Gendhalal, Jam Singh and many others from Neemkheda lived a life that was a daily grind for survival. Today, all of them take pride in their work. They look forward to sharing their skills of environment regeneration with villagers from the rest of Madhya Pradesh. Kamal and his friends will be part of the faculty of the institute and soon they will be showing others all about underground dykes, farm ponds, contour bunding, afforestation, gabian structures...

IRRIGATION PLANNING

Water: its economics & politics

H. M. DESARDA illustrates from Maharshtra's experience how a lopsided approach to irrigation and distorted water consumption patterns threaten to result in 'water wars.'

TO begin with it may be useful to clear a few conceptual cob webs First and foremost, drought is a natural phenomenon, whereas famine is man-made. Less than 75 per cent of annual average rainfall characterises a particular meteorological region as drought-affected during the year. In common parlance, it means scarcity of water for drinking and domestic use, besides an inadequate moisture for normal farm production.

Of course, meteorological drought need not invariably turn into agricultural and hydrological drought, i.e. food and water famine. In fact, the adverse effects of meteorological drought are overcome by ingenuity of planning and the experience of adjusting to erratic and deficient rainfall. After all, what is the meaning of water resources planning and policy if it does not succeed in effective drought-proofing? All in all, the global and Indian experience shows that even precipitation of 400 to 500 mm (average for Maharashtra is 1200 mm and no area is below 500 mm) if properly harvested can provide livelihood security. That means by proper planning, drinking water, fodder, fuel-wood and basic staple food can be ensured even when the monsoon is erratic and deficient.

It is intriguing that a State with half of the country's large dams is haunted by water scarcity of a catastrophic dimension.

Irrigation and hydropolitics:

As of now, Maharashtra has invested nearly Rs. 6000 crores on creating major and medium surface storages and extending canals. The Irrigation Department claims an irrigation "potential creation" of 26.63 lakh hectares. However, in the past 15 years the area actually irrigated has been between 4 to 10 lakh hectares. Put simply, just 5 per cent of the crop area in the State has the benefit of surface irrigation. More minute analysis would show that in actual physical terms, the area irrigated is at best 4 to 5 lakh hectares. Further, if we exclude the area irrigated by lifting the water from reservoirs or canals the actual gravity flow based irrigation is less than 3 lakh hectares or just 1.5 per cent against the claimed 13 per cent. It may sound very strange but such is the sad story which comes to the fore when one delves deep into the irrigation reality in Maharashtra. Interesting enough, according to the record of the International Commission on Large Dams, Maharashtra is the biggest builder of large dams (more than 15m high) in the world. Today, the State has the dubious distinction of having completed construction of 1,200 large dams. Another 400 are under execution. Is it not really intriguing that a State with half of the country's large dams is haunted by water scarcity of a catastrophic dimension?

The dismal performance of irrigation brings out that the protective and drought-proofing aspects were given the go-by during the post-Independence phase, in particular after the creation of Maharashtra State in 1960. In fact, during British rule, in the wake of the Deccan Riots (1885), much of the irrigation system was designed quite differently, where water was stored in high rainfall ghat areas and carried to rain shadow areas. Most of the storages were pick-up weirs and the run-of-the river system was operative. But later when 'Sugarcane blocks' were introduced, the original scientific and sustainable approach was given the go-by. In retrospect it appears that the Maharashtra Irrigation Commission (1960) gave a wrong direction to water planning. The result is an inefficient and sick irrigation system today. Therefore, unless and until the entire system is overhauled and its direction changed, the problem of frequent famines can never be tackled. The *raison d'etre* of the prevailing irrigation system is faulty and hence expansion of such irrigation works is most harmful. Surely, it is not at all an answer to the ever growing water scarcity. Given the most dismal state-of-the-art and sordid state of affairs, there is an immediate need to appoint a broad-based Irrigation Commission to look into these issues and suggest reforms and remedies. For the past 30 years the State has been allocating between 20 to 25 per cent of total Plan funds to this sector, which has become totally sick and has reached a point of no return. During the 1960s provision of Rs. 50 crore created nearly a lakh hectares of additional potential. During the 1970s it required Rs. 300 crores and in the 1980s Rs. 600 crores. Today it swallows around Rs. 1,000 crores, and even on paper, adds no more than 60,000 hectares!

Dams do store water, but at what cost and for whom? This question is an environmental fundamentalism or a fad to development champions, great policy-makers and the powers that be. Thus, the scandalous state of the State's irrigation and viable alternatives painstakingly worked out by educated social activists have totally exposed the futility of the prevailing system and have paved the way for people-oriented, instead of project-oriented, systems of water-planning.

The projects like Ujjini (Sholapur) and Jayakawdi (Aurangabad-Marathwada) on both of which more than Rs. 500 crore each have already been spent are classic examples to show how projects are planned, ignoring basic socio-economic and environmental considerations. The deep black soils in planned command areas of both projects are the most ill-drained soils. And as the drainage components are conspicuously missing in the project design itself, even with a few trial irrigation rotations the soil is getting spoiled on

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Looking for water during a drought in a State which has the largest number of dams.

account of salinity and alkalinity. Thanks to the inefficiency of the system the irrigation water is not 'spread' all over the command area, and water-logging is bound to be a serious menace. It would render soils permanently unfit for crop growth.

Changing priority

Another very curious change in the State's irrigation sector is the shift in the purpose of water use and priority. Currently, most irrigation projects have become the primary sources of drinking water and are industrial-use supply schemes. Thus the major use is for homes and industry, in lieu of irrigation. Incidentally, Maharashtra deviated from the National Water Policy by putting industry in the second place, instead of irrigation.

To cap it all, just 3 per cent of the total cropped area, occupied by sugarcane, is pre-empting 76 per cent of irrigation water, both surface and underground. In this scenario all other crops are denied even 'life saving' irrigation; the basis on which most early projects were planned. This has distorted the pattern of agricultural growth in the State. Today, as many as 18 lakh agricultural pumps, which are charged a flat horse power tariff, are mindlessly mining ground water. The drying of the village drinking water wells and the sharply receding underground water-table is the fall out of these environmentally unsound policies and practices and agricultural development in Maharashtra.

Alternative

In the light of the foregoing discussion and issues the central question is what is the most effective approach to drought-proofing and enhancing effective water availability? Soil and water conservation on a microwatershed basis through a fairly wellspread, effective permanent vegetation cover is the solution to mitigate the incidence of recurrent famines. Through this alone the decline in agriculture can be arrested. Careful and conscious resource regeneration and conservation is the pressing need of stagnant agriculture, sans which land degradation by pervasive erosion, salinity and waterlogging , deforestation, decline in vegetation cover and depletion of water by overdraft and pollution by chemicalisation can never be tackled satisfactorily.

Watershed development is the only method and measure by which the problems of drought, scarcity, low productivity and environmental damage can be tackled. Regrettably, the present progress in this respect is far from satisfactory. As much as 10 million hectares of the cultivated land and an almost equal size of the waste and forest land in Maharashtra requires watershed improvement treatment, i.e. soil and water conservation, vegetative cover and afforestation. Though the soil conservation work has been underway for nearly 60 years, no more than 6 per cent of the State's cultivated area has been treated so far. In this respect the fact to note is that at present the maximum area treated every year is around one lakh hectares. Moreover, the quality of the work is far from what is required. Besides, at this pace it would take more than 100 years to carry out the task. Given the alarming rate of soil loss of more than 20 tonnes per hectare what will be left by then? It is a stupendous task but by no means insuperable; its import and implications should be grasped with the seriousness it deserves.

Conceptually speaking, it means ridge to valley treatment so that hydrological, soil and biotic regimes are symbiotically developed. The edifice of this is scientific land use planning to stop further resource degradation and satisfaction of production through the farming system approach, which takes care of conservation and regeneration and ensures current needs Even though the Government launched the Comprehensive Watershed Development Programme in 1983 progress has been very dismal. The Agriculture Department claims that thus far 4,999 watersheds covering 6.5 per cent of rainfed area have been completed But the impact is not seen except in villages like Ralegaonsiddhi, Adgaon and a few more, because the crucial component of community participation has been missing. It is useful to note that even the work done by successful NGOs is done by utilising government funds and schemes. Thus there is no point in creating a cult of 'voluntarism'. The necessary institutional framework has to be evolved. The key factor which makes the qualitative difference is people's participation.

What is the way out of the (water) web? At the juncture in our (development) journey we have enough experience to warn and guide us about the resource squandering path we are blindly pursuing. Water being the pivot of the life-support system the corrective has to begin with it. In a densely populated, industrialised and urbanised State such as Maharashtra the first corrective step is to change the water intensive path of agricultural and industrial production and the ecologically destructive resource-use model of growth.

At present the short-sighted technocratic and engineering approach which dominates water-use project has distorted the size, scale and sequence of impounding water. Instead of planning from ridge to valley f

A check dam at Ralegaon Siddhi village: community participation can make a world of difference to water availability.

the total river basin they design the project at lower ends, thereby altogether neglecting catchment areas and upstream population. This leads to large-scale displacement, enhances financial cost and creates social inequity. The ultimate result is recurrent famines and chronic water shortage.

Role of forests

In view of the character of the monsoon, concentration of rainfall during a few weeks and limited hours of heavy rain-storms, there is need to store water for the dry spell and the non-monsoon period. But the mistake is to forget easy and natural ways of storing water: like soil profile, vegetative cover, trees and aquifers. Through these *in-situ* methods and measures alone, water can be stored and conserved meaningfully. All in all, the trees are the live tanks. It is high time we recognise the unique role trees play in sustainably storing the water. The main yield of forests is not wood but water.

A cursory look at the forest area statistics should suffice. In 11 districts out of 30 in Maharashtra the percentage of forest to the geographical area is less than 10 per cent. In fact, in three of them it is less than one per cent. For another 10 districts this figure is between 10 and 20 per cent. Surface storages, and that too the mega dams and reservoirs, are adopted as the predominant mode of storing water. This is responsible for the alarming situation in respect of drinking water. Hence, this myopic techno-engineering model should be replaced by a meaningful socio ecological path by which water can be harnessed by maintaining the organic link and inter-relationship of the hydrological cycle — the transfer of water in sea, air and land. The crux of water planning is to harvest as much water as is possible through natural entities by means and methods which are ecologically sound.

In sum, it is not the failure of rains which is the cause of famines and water scarcity but the pursuit of wrong policies and a resource-squandering strategy of development, perpetrated blatantly despite its utter bankruptcy and the disastrous consequences.

The upshot of this exercise is that decisive and substantial devolution of resources, decentralisation of the decision-making process, changing of the consumption pattern and ending the water-wasting life styles of the top 20 per cent have to be carried out for a permanent solution

Given the autarky in water use planning and anarchy in water use patterns Maharashtra is heading towards water wars of the worst kind. The hydro-politics from the Pravara basin (the struggle over sharing the Bhandardara dam water among the various factions of the sugar lobby on the one hand and common cultivators and people on the other) to the Vasai Virar people's protest to protect their water rights and resources should suffice to warn about the unfolding scenario.

(The author is a member of the Maharashtra State Planning Board. However, these are his personal views and should not be attributed to the Board)

HARVESTING RAIN

Water storages in saline lands

SHAILENDRA YASHWANT, Staff Photographer, tells a picture-story about a non-governmental effort in a barren part of South Gujarat which has made scarcity of water a thing of the past.

AROUND the Gulf of Khambat in South Gujarat lies the barren land of Bhal — which literally means "a forehead where nothing grows". This region suffers from a hostile geoclimatic environment high salinity, erratic rains, monsoon inundation, temperature extremes and even coastal cyclones.

In the midst of these saline waste lands of Bhal is the Dholera region in the Dhanduka taluk of Ahmedabad district. Over 50 years ago, Dholera was a major port and centre of trade. But indiscriminate tree felling, free grazing for camels and deforestation led to a deterioration in the soil quality of the land. The development of Bhavnagar port and the gradual decline of Dholera resulted in large-scale migration. The population of Dholera has decreased dramatically in the last two decades, from 40,000 to 5,000.

By the year 1979-80, about 49 per cent of the land in the 40 villages of the Dholera region (about 601,736 hectares) was unfit for cultivation. Though the mean rainfall is about 500 mm, large annual variations result in both droughts and floods.

The region has a very high water table, about 2 to 3 metres below the ground. Unfortunately, this water is more saline than sea water. The high water table results in continuous capillary action during summer which leads to salt being deposited on the surface. The proximity of the sea and the flat terrain makes the land susceptible to inundation which, in turn, increases the salinity.

A combination of an acute drinking water shortage because of non-availability of sweet water, poverty due to low agricultural productivity and the increasing dependence on government programmes has resulted in an apathetic and fatalistic attitude amongst the people.

The people here are basically Darbars, Koli Patels and Harijans. They grow wheat, jowar, cotton and bajra on land under minor irrigation schemes. Some are also involved in the diamond polishing trade. But for almost eight months in a year they are compelled to migrate to other areas. Many of them are virtually bonded to the contractors from whom they have taken loans and advances.

The region has a very high water table but the water is more saline than sea water.

In the year 1978-79, Utthan, a team of young professionals from Ahmedabad, decided to do something for the development of the Dholera area. They realised that the local people basically needed information and training so that they could help themselves.

With that in mind Utthan set up a project called Mahiti (Information). The team believed that knowledge would lead to awareness which, in turn, would lead to sustainable development. The introduction of

n Mingalpur village in Dholera taluka: women stand on what creates a problem for everyday life: the salt leposits raised to the surface by salinity in the soil.

Shailendra Yashwant

In Panchi village in Dholera: women stand near a lined pond that has changed their lives.

alternative water harvesting projects for drinking water purposes was considered to be one of the first steps in the general development of the area. With the help of Dr. P. P. Patel, a geologist from M. S. University, Baroda, members of Utthan began to search for water resources in the otherwise vast tracts of saline wastelands. A critical evaluation of the geo-climatic characteristics of the region revealed some potential. They decided to develop the technique of rainwater conservation by building lined ponds. These seemed to be the most suitable for the conditions in Bhal.

Almost the entire area of Bhal is a 'no-source area'. The water supply to the villages was both irregular and inadequate. The traditional water sources such as village ponds and pond wells are not only inadequate but of poor quality.

They have been neglected, the walls of many wells have broken down and desilting has not been done for many years. With high evaporation, progressive contamination of water by salt and subsurface losses have rendered these traditional village sources dry for over eight months a year.

The ambitious 213 km long Sabarmati regional water supply scheme that serves the 60 villages of Dhanduka and Dholka taluk is riddled with various problems including tampering and pilferage of the supply. In effect, during summer most of the tail-end villages have to do with almost no water.

According to Dr. P. P. Patel, plastic lined ponds are an improvement on the traditional ponds. By covering the entire pond bed with a plastic film, the salt contamination from the earth and seepage losses from the bed can be totally prevented. The plastic film has to be protected by brick lining on the sloping sides of the pond and a thick cover of sweet soil at the bottom of the pond.

The lined pond, which costs about Rs. 7 lakhs, serves as a storage reservoir for raw water collected during the four months of the monsoon. Through a network of canals, the water can be used for purposes

Shailendra Yashwant

Near a cattle trough next to a lined pond in Gandhipur village there is no longer any need to consider migration to escape from saline water

Shailendra Yashwant

A member of Mahiti-Utthan checks the quality of water at a filter plant of a lined pond in Dholera: the wonders that voluntary effort can do.

of social forestry and protective irrigation of the kharif crop.

The fact that many of the men and women from these villages had worked on lined canals in the areas around Ahmedabad proved to be an added benefit. With a trained work force, adequate guidance and technological know-how, the experiment of the lined ponds had to succeed.

The Mahiti-Utthan volunteers who had begun grassroot-level income generation activities, social afforestation, smokeless chulas and savings and credit schemes had won the trust of most of the women. Women's groups were organised and the work on the lined ponds began with the villagers in the area.

Taking advantage of the best geomorphic features

With a trained work force, the experiment with lined ponds had to succeed.

of catchment and storage sites, the engineers identified the sites and the dimensions for the scheme. They made provisions to control seepage and salinity by lining the storage bed and to reduce evaporation loss by appropriate techniques of compartmentalisation and the use of chemical retardants.

The gross storage requirement was calculated at the rate of 40 litres per capita per day and with a storage facility of 270 days, excluding 100 days of monsoon. On this basis, the size of the pond was worked out. Its maximum depth was worked out on the basis of the height of the permanent water table. The bottom of the pond is filled with sweet soil to cover the 'Agri-

Some of the people in Dholera have now given up the idea of migration.

film' (trade name of the IPCL product used in the Mahiti project) and the film on the side-slopes is protected by brick lining.

Catchment development takes care of the uninterrupted flow of water which fills the pond through a carefully designed inlet system with an entry gate, inlet valve, silt trap, etc. The water from the storage pond flows to the filter plant through gravity. The filter plant is designed to store 15,000 litres with a filter chamber of 3m x 2.5m.

Today there are about 18 lined ponds that have been constructed in the Dholera region by Mahiti-Utthan with aid from the World Bank. People's participation is encouraged for the maintenance of these lined ponds. The villagers have become more or less self-sufficient as far as their need for water is concerned. A few of them have even given up the idea of seasonal migration and look forward to cultivating their land.

SOLID WASTE MANAGEMENT

SOLID WASTE MANAGEMENT

Introduction

Collection, transportation and disposal of solid waste is an essential urban basic service for the protection of environment and maintenance of health and sanitation in the urban areas.

In India, this service falls short of the desired level, as the systems adopted are outdated and inefficient. Institutional weakness, shortage of human and financial resources, improper choice of technology and lack of short and long term planning are responsible for the inadequacy of this service. The solid waste management practices in this country therefore need a substantial improvement keeping pace with the rapid urbanization and all round development.

For maximising the efficiency and effectiveness of this service, it is necessary to tackle this problem systematically by going into all aspects of the solid waste management and device cost effective system which may ensure adequate level of solid waste management service to all class of citizens, safeguard public health and improve the quality of life.

Bangalore with enormous waste materials generated everyday continuously confronts the problem of disposal of garbage. There needs immediate action for a systematic assessment of the hazardous waste and its indiscriminate disposal.

Under solid waste management, attention should be focussed mainly on the issues like- identification of suitable sanitary landfill sites, monitoring the existing land fill sites for environmental impact assessment, composting, Incineration of hazardous waste and separation of organic waste from non organic waste.

THE PRESENT SCENARIO OF SOLID WASTE MANAGEMENT:

GENERATION OF WASTE

It is estimated that 2,500 M.Ton of Solid Waste is generated in the city of Bangalore each day as under:-

Source of generation of waste	Qty.
(1) Household waste	1,000 M.Tons
(2) Shops, Esblishments, offices, institutions	600 M.Tons
(3) Markets	600 M.Tons
(4) Other waste	300 M Tons
TOTAL	2,500 M.Tons

The city is following an outdated and inefficient method of storage, collection, transportation and disposal of waste and the problem is becoming acute over the passage of time raising serious problems of health and sanitation for the city.

STORAGE OF WASTE AT SOURCE:

Only 50% of the households, shops and establishments in the city store waste at source in plastic buckets or in metallic bins or polythene bags etc. rest of the citizens do not store waste at source and instead dispose of waste on the streets or in the municipal bins if nearby.

SEGREGATION OF RECYCLABLE WASTE:

The households segregate only the recyclable material which is sold to Kabadiwallas such as newspapers, plastic material, bottles etc. but by and large they throw waste-paper, plastic, broken glass, metal etc. which is not required along with the domestic waste.

PRIMARY COLLECTION OF WASTE:

COLLECTION OF DOMESTIC & TRADE WASTE:

There is no system established in the city for primary collection of waste either from the doorsteps or from community bins. Generally the waste is being collected through street sweeping which is the main system of primary collection of waste. However, recently efforts are being made for doorstep collection of waste through NGOs and private contractors and about 5% population is covered under such system. Rest of the waste is therefore either collected from the street or from the dust bins.

COLLECTION OF HOSPITAL WASTE

The city has 186 number of hospitals and nursing homes. No system of primary collection of hospital waste exists in the municipal corporation in the city. A few hospitals have their own incinerators whereas rest of them do not have any facility of incineration of hospital waste nor a common facility is created by the corporation or private sector for the disposal of hospital waste. Most of the hospital waste therefore gets mixed with the municipal solid waste.

WASTE FROM HOTELS AND RESTAURANTS:

The municipal corporation has, by an administrative order, given directions to the hotels and restaurants to make their own arrangements for collection and transportation of the hotel waste and to dispose of in the manner prescribed by the corporation. In furtherance to this order the hotels and restaurants have made their own arrangements of collection of hotel waste from the hotels and restaurants and they dispose of their waste on the municipal disposal sites. The corporation does not handle the collection of this waste nor the hotels and restaurants are allowed to dispose of their waste in the dust bins placed inside the city.

COLLECTION OF CONSTRUCTION WASTE:

There is no arrangement made for the primary collection of construction waste. The Engineering Division of the Corporation removes the construction waste unauthorisedly disposed of by the people from time to time.

COLLECTION OF MARKET WASTE :

There are 115 small and big markets in the city. 12 of them are big vegetable , fruit and meat markets.

No special arrangements are made for the collection of waste from these markets..Waste is thrown on the streets .

PROVISION OF DUST BINS:

There are about 14000 bottomless cement bins having 0.9 mtr. dia. and 0.6 cu. mtr. storage capacity and large masonry bins for depositing of waste at a distance of about 100 to 200 meters.. Besides there are 1500 places where the waste is deposited but no bins are kept so far on these sites. Recently metal containers are placed and by now only 55 metal containers are placed in the city for the storage of waste in an hygienic manner.

The frequency of removal of waste vary from place to place. In the commercial area the waste is removed daily, whereas from other bins the waste is collected on alternate days.

STREET SWEEPING

In absence of adequate arrangements for primary collection of waste, street sweeping has been the main system for collection of waste.
The street sweepers are given continuous duty in one shift from 6.30 a.m. to 1.30 p.m. with half an hour's recess from 10.30 a.m. to 11.00 a.m. The sweeping is carried out on all days of the year including all holidays. Weekly off is given to them in 2 parts - half a day on Wednesday and half a day on Sunday, whereas half a day's off is given on all holidays.

WORK NORMS OF SWEEPERS:

The city has a total road length of 1924.81 Kms.. An area of 20000 sq. ft i.e. about 2000 sq. mtrs. of road length is given to the sweepers for street-sweeping.

STRENGTH OF SWEEPERS:

The sanctioned strength of the personnel for the city cleaning operation is shown in column 2 in the table below. Several posts of sweepers and supervisory staff are vacant. The Corporation has therefore started taking sweepers on contract and the present position of the

personnel actually working in the Corporation is shown is column 3 of the table below.

TABLE 1

	Designation	Sanctioned strength	Working strength
1.	Health officer	1	1
2.	Add.Health Officer	3	3
3.	Dy. Heath Officer	6	6
4.	Medical Officer of Health	17	17
5.	Sr. Health Inspectors	100	77
6.	Jr.Health Inspectors	200	200
7.	Sanitary Daffedars	200	169
8.	Pourakarmika's B.C.C.	8246	5896
	--Contract--		5435

UTILIZATION OF STAFF

The city has 100 election wards. These are divided into 252 Health Wards for sanitation purposes. Out of these 252 wards, street sweeping, collection and transportation of waste from 56 wards is being done by the regular staff of the Corporation. Whereas, in 72 another health wards street sweeping is done by the Corporation sweepers but the waste is transported through hired vehicles. The remaining 124 wards are being rendered services of collection and transportation through contractors by inviting tenders.

TOOLS GIVEN TO SWEEPERS:

The sweepers are given very limited tools .one handcart is given between 10 sweepers and one metal plate is given every 6 months. 10 Kg. broom sticks are given per quarter for making brooms and one basket is given per quarter for transporting waste.

TRANSPORTATION OF WASTE:

The transportation of waste is done in 2 ways, (1) departmentally by engaging 82 trucks of the Corporation and (2) through contractors by

engaging 129 vehicles for layout and markets and 72 lorries on contract for transportation of waste.Besides this the Corporation has 13 Dumper Placers for transporting metallic containers of 2.5 to 3 tonne capacity and 6 mini-compactors for transportation of waste.The contractors collect and transport all the waste in their own vehicles from 124 out of 252 health wards of the city. They also pick up waste from S.KR.M & Russel Markets.

PROCESSING OF WASTE :

The city corporation has entered into an arrangement with a private entrepreneur M/s Sunrise Enterprise, and Karnataka Compost Development Corporation for the treatment and conversion of municipal solid waste into bio-organic fertilizer. M/s. Sunrise Enterprise has set up his own plant on private land and is receiving 300 M.Tons of waste per day at the plant site from the corporation for its treatment. Similarly M/s. KCDC is also receiving 150 to 200 tons of waste at its plant for conversion of garbage into a compost.

Another private entrepreneur M/s Terra pharma is also managing to get another 70 to 80 tons of waste from the Corporation for conversion of waste into a compost through vermi-composting. In addition to this NGOs viz. Swabhimana and Exonora are also collecting Kitchen waste for converting into manure through vermi-culture.

The entire responsibility of treatment and sale of end product is of the private entrepreneurs. The Corporation has no liability or obligation to perform except to deliver the fixed quantity of waste at the plant site. The rest of the waste generated in the city is not processed and disposed off in an unscientific manner.

DISPOSAL OF DOMESTIC, TRADE AND INSTITUTIONAL WASTE:

The municipal corporation until recently did not have any site identified for the disposal of waste. In absence of the landfill site or any arrangement for waste disposal, the waste was being disposed off by the Corporation on the road sides outside the municipal limits without any consideration of environmental degradation. Huge amount of waste is piled up on both the sides of the roads covering a very big area giving rise to unhygeinic conditions

Of late the corporation has, after a Public Interest Litigation filed in the Hon.Supreme Court of India, made a serious efforts to identify the

landfill sites and has finally identified 7 landfill sites in different parts of the city as shown below:

Sr.	Name of the site	Area of land
1	B. Narayanpuram	10.15 acres
2	Hennur Banaswada	10.50 acres
3	Vibhutipuram	8.01 acres
4	Devara Chikkana Halli	6 09acres
5	Audugodi	2.00 acres
6	Honagasandra	2.00 acres
7	Sarakhi	2.00 acres

The total area of these sites is 40.75 acres and the capacity of is 986966 cu.ms which may last the Corporation for hardly 12 months if the entire waste is disposed of at these landfill sites.

The corporation has started preparing the landfill sites and is likely to resume the disposal of waste at the identified landfill sites shortly. The availability of the land is close to residential area. Therefore efforts are being made by the corporation to handle the site efficiently to avoid any public grievance for setting up the the landfill sites close to their residential area.

The disposal of hospital waste , hotel waste, market waste etc. is also not done scientifically and all these wastes are also disposed off on the roadside in the same way as municipal solid waste is disposed of by the corporation.

WORKSHOP FACILITIES :

The city corporation has a very ill-equipped workshop with very little staff to handle maintenance of the vehicles. The number of vehicles maintained by the workshop and the staff position is shown in Annexure B.

LANDFILL SITING CRITERIA

The heart and life-line of any waste-management strategy is availability of land for composting sites and adjacent or nearby landfills for their non-toxic compost rejects. Yet these are the most unwanted of neighbours, their locations strenuously opposed by the public because of their nuisance and polluting value if poorly managed, and the fear of property values crashing around them. To overcome this NIMBY syndrome (Not In My Back Yard!), proposed sites must comply with the following criteria:

Waste-Processing and Disposal Sites SHOULD BE:

1. Large enough in area to last for 25 or minimum 15 years. Seek new sites when 10 years' life is left.

2. Preferably be far enough from the present city limits, (3-5 km for cities upto 5 lakh population and 5-10 km for larger cities) to ensure long life of the compost site even when the city expands, while keeping transport costs as low as possible.

3. At least 300 meters and preferably 500 meters away from nearest habitation or planned housing development sites. {NEERI recommends 200 m]. (It is easier to relocate the housing or industrial project than to find a waste-processing-site meeting all criteria).

4. In between major highways (along which ribbon development always takes place) and preferably 500 meters from a Major District Road and larger roads. Daily garbage traffic should avoid National Highways.

5. At least 500 meters away from a perennial stream or major seasonal river-bed, or the high-water-mark of a lake and at least 200 meters from minor streams over 10 m wide, or the high-water mark of a minor tank, or an open well used by locals.

6. Located preferably across the river from the main populated area, to prevent rapid urban expansion near it.

7. Preferably avoid routing options which will severely overburden

8. Preferably located within a city's "green belt", where urban development is restricted.

9. A buffer zone of No-Development should be declared in the Town Planning Dept's land-use plans, to prevent objections by future neighbours in later years before the site life is exhausted.

10. The 'No-Development" status of Survey Numbers within this buffer zone must be entered on the Village RTC (Record of Tenancy and Crops) or Property Registers of surrounding towns, to alert persons considering the purchase of unauthorised house sites in such areas.

11. Should preferably be on low-porosity or stony ground, preferably with a slight natural slope for collection of leachate. Vehicle movement during monsoon should be possible.

12. The bottom of any rejects-landfills should be at least 3 meters above the highest seasonal ground-water levels.

13. A nearby source of impervious clay for lining the landfill is an added advantage.

14. Preferably have access to power supply and water (piped or on-site). Primary-treated sewage water is often acceptable.

15. Many large cities with scarce land often have sewage-treatment plant or grass-farm lands which are suitable for compost-plants, which can also co-compost non-toxic sewage sludge. If necessary, the compost rejects needing permanent disposal can be transported to an alternate location.

16. Since almost all such sites will necessarily lie outside the city limits of Class 1 Cities, the compost-yard should be designed for and be prepared to accept free delivery and processing of garbage from the host Panchayat or the Urban Development / Improvement Trust or City Municipal Council within whose territory the proposed compost-yard is being planned.

17. In highly-crowded areas of ribbon development as in Kerala, it may be necessary for Class 1 cities to additionally pay some "acceptance fees" to their under-funded "host" local bodies to enable them to maintain their minor roads which will be subjected to heavy traffic from waste-transport vehicles. This cost must be considered when choosing between alternative sites.

18. Concerned local and High Courts should be informed of proposed site use and requested by the ULB in writing well in advance, to be given a hearing before passing of any stay orders (preferably time-bound, with max 3 months for proving title etc) on the Survey Nos proposed for waste-processing use. This is to prevent legal delays.

19. The public should be involved, through public meetings and school tours of well-managed facilites, in developing the concept of waste management, to achieve as wide a consensus as possible for local waste management, in particular with regard to the facilities required.

Compost-yards and their rejects-landfills <u>SHOULD NOT BE</u>:

A. Close to airports, ammunition dumps or explosives factories, petroleum or gas depots and similar safeguarded areas, National Parks, Wetlands, Monuments, or important cultural places of historical or religious interest or great natural beauty.

B. Within the Coastal Regulation Zone or within the catchment area of existing or planned drinking-water-supply projects.

C. On porous limestone ("karst") formations (a problem in sub-Himalayan regions) or over fractured rock with a high water-table.

D. In active eqrthquake-prone fault zones or in areas prone to subsidence or settlement (e.g. over abandoned mines)

E. In highly flood-prone areas. (In the Gangetic plains, composting sites may have to be built up on raised platforms of debris etc or mining overburden to keep the garbage above flood-water levels).

F. On prime highly-fertile agricultural land if alternatives exist.

G. Beyond railway tracks having railway gates and heavy rail traffic which will regularly delay garbage-transport vehicles from making sufficient trips.

H. Within a steep valley, ravine or gully carrying water to a seasonal stream. Hill stations may need to locate sites at the foot of the hill or nearest level ground, or plug and terrace a gully right at the top, to create a level erosion-free space for unloading of trucks and compost preparation and turning using front-end loaders. Animal transport and manual turning of compost will suffice only for smaller quantities using more than one location. (Dumping garbage over the edge is NOT the solution!)

I. Within an operating or abandoned quarry-pit where leachate flows cannot be collected by gravity for daily observation and treatment. (Germany will build only hill and slope landfills in future, no more pit landfills in which it is not possible to siphon off seepage water by gravity. Ref : TA Siedlungsabfall 1.6.1993).

J. <u>Note</u>: Old quarries and low-lying areas within a city may be earmarked for filling only with construction waste, debris, road-waste, road dust, silt from open drains & similar non-toxic inert material, without any prior preparation.After filling, such sites should preferably be reserved as open spaces: parks, playgrounds, exhibition-grounds or parking-lots with trees.

PRIOR CLEARANCES REQUIRED BEFORE FINAL SITE SELECTION :

1. Airport Authority or Air Force aerodromes where relevant.
2. Defence Dept, as well as Atomic Energy Commission where relevant.
3. State Electricity Authority (to avoid any structures beneath proposed HT lines)
4. Highway authoirty if any, to avoid a site on a proposed highway alignment.
5. Central or State Ground Water Board (to avoid polluting important aquifers)
6. Mines & Geology Dept (to avoid heavily-fractured rock or unstable soils). Consultations with the local Soil Science Dept plus test bore-holes to determine the depth of groundwater and of impervious strata are recommended. Also a contour survey.
7. Local Town Planning Authority, for clearing the land-use, declaring a No-Development Buffer Zone, and specifying the eventual use of the site [to govern its mode of use and development and restoration].. Their written refusal if any should clearly specify alternate sites for consideration.
8. The host Local Body (Urban or Rural) in whose land the site is proposed.
9. State Revenue Dept if it is Govt land. (Private land purchases allowed).
10. Site acceptance by the private/jt waste-processor who plans to operate there.
11. Approval of the SPCB (State Pollution Control Board, or Pollution Control Committee of any Union Territory), specifying the attached conditions subject to which such clearance is given, in order to ensure that health and environmental quality, and in particular water quality, are safeguarded, or for separate stocking of topsoil for eventual landfill capping cover.
12. Public hearing at or near the proposed site, especially with nearest inhabitants after adequate local publicity and a press note giving route directions and time. (It is of the utmost importance to take the locals into confidence and address their fears or agree to their specific reasonable conditions as early as possible).

Informal discussions with relevant parties are advisable before submitting the formal application. These talks should be based on results of an initial reconnaissance study of soil and surface water, current and Zoning-plan land use, Survey No and status of the site in village records, approach roads and route from the city, and suggested layout plan. A map or sketch of the surrounding area and a contour plan are useful at this stage.

All clearances should be automatically given within 6 weeks unless it is against the National interest or will pose grave threats to public health or major ground-water resources. Reasons for refusal of site clearance to be clearly justified in writing within 6 weeks of application for no-objection by the ULB seeking such clearance. Conditions, if desired by any of these agencies, may be intimated to the SPCB, to be attached to its own clearances in the interest of public health and safety. The SPCB should be the agency monitoring compliance with stipulated conditions.

THE OCCUPATIONAL HEALTH RISKS OF WASTE COLLECTION AND RECYCLING

This chapter evaluates two studies dealing with the health and environmental effects of waste collection and dumping. It also gives an overview of opinions of resource persons in India on the health effects of waste collection and recycling.

4.1. Waste and health, two case-study evaluations[16]

Both studies were undertaken by the All India Institute of Hygiene and Public Health in Calcutta.

The first study

Socio-economic and Health Aspects of Recycling of Urban Solid Waste Through Scavenging. 1987-1991. All Indian Institute of Hygiene and Public Health Calcutta, sponsored by the World Health Organization.

Objective of the study

To collect base-line information on the status of waste picking, to evaluate the health risk regarding the working and living environment of waste pickers and to study the socio-economic aspects of waste picking.

Methodology used

Literature review
Interviews
Physical examination
- Selection of the waste pickers by random sampling
- Selection of a control group

Number of respondents

For the epidemiological study 400 waste pickers were selected, from three different areas in the city, and a control group of 50. During the research the waste pickers and their control group appeared to be almost identical in malnourishment, as was their socio-economic status and living environment concerned.

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[16] The analysis of the studies presented follow the same structure as in the first study (UWEP Working Document 4 - Part I). Only the format is different because these studies are much more detailed than the ones analyzed in Part I.

Elaboration of the findings

The outcome of the study regarding the health of the waste pickers as compared to the control group was as follows:

	Waste pickers	Control group
Respiratory diseases	71%	34%
Diarrhoea	55%	25%
Viral hepatitis	32%	2%
Protozoal and helminthic infestation	25%	25%
Skin diseases	15%	18%

Table 4.1. Comparison of the findings

Regarding most of the illnesses the condition of the waste pickers was worse compared to the control group. But, remarkably, skin diseases were more prevalent among the control group than among the waste pickers. The prevalence of protozoal and helminthic infestation was the same among waste pickers and the control group.

It was concluded that waste picking is hazardous. The epidemiological study shows that of the three open systems of the body (the respiratory tract, the gastro-intestinal system and the skin) the waste pickers are particularly vulnerable to the diseases of the respiratory tract and the gastro-intestinal tract. However, no further explanations were given in the study for the differences found between the two groups.

The second study

Health Impact of Dumping and Recycling of Solid Waste in Calcutta, Draft Report. 1995-1996. All India Institute of Hygiene and Public Health Calcutta, sponsored by Birmingham University.

Objective of the study

To study the impact of environment and occupation on the health of solid waste handlers, and to evaluate the impact of waste dumps on the environment.

Methodology used

A cross-sectional epidemiological assessment of the environmental and occupational health hazards associated with waste recycling and disposal was undertaken amongst the waste pickers living near the waste disposal sites, and street pickers working and living on the

streets of Calcutta. Questionnaires were used and clinical examinations were carried out of all groups. Furthermore, water and air quality measures were taken.

Number of respondents/samples

* 25 Dump site waste pickers residing near the dumping ground
* 37 Street waste pickers
* 23 Dump site residents not involved in waste picking
* 21 Municipal garbage workers
* Water samples from drinking water wells (tube wells and open wells) (used by waste pickers and disposal ground residents not involved in waste picking) and ponds which were analyzed for physical, chemical and biological parameters. Samples were taken from four ponds: two ponds within the disposal ground, the third was a fish pond and the fourth was used by a *dhobi* (washerman).
* Control group I (N=22)
* Control group II (N=26)

Initially one control group was selected, living three kilometres away from the dumping site, but during the study it was found out that this group had a slightly better income than the study group and for that reason another control group was selected, living 25 kilometres away from the dumping ground. And although later it was found out that they had a slightly poorer economic status than the study group, the study was compieted using these two control groups.

Elaboration of the findings regarding health and environmental pollution

	dump site waste pickers	dump site residents	street pickers	municipal garbage workers	control I	control II
Vaccine against tetanus	< 25%	< 25%	< 25%	< 25%	< 25%	< 25%
Chronic backache	76%	62%	51%	33%	59%	77%
General weakness	68%	70%	43%	19%	n.a.	n.a.
Cough, respir. diseases	48%	35%	n.a.	5%	9%	42%
Chest pain	48%	39%	32%	19%	27%	54%
Pain abdomen	52%	56%	46%	24%	54%	31%
Jaundice	44%	39%	35%	0%	18%	27%
Dog and rat bites	28%	30%	16%	0%	9%	4%
Diarrhoea	72%	48%	54%	19%	55%	23%
Cuts injuries	48%	74%	46%	0%	14%	19%
Eye injuries, other eye problems	8%	13%	5%	0%	5%	0%
Skin diseases	64%	39%	16%	19%	14%	8%
Ulcers	12%	17%	16%	0%	9%	4%

Table 4.2 Results regarding health from questionnaires

What is remarkable from these figures is that the health of municipal garbage workers is better than that of the other groups. Except for ulcers, the health of the street waste pickers is better than the health of the dump site waste pickers.

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	dump site waste pickers	dump site residents	street pickers	municipal garbage workers	control I	control II
Angular stomatitis	40%	30%	40%	0%	18%	31%
Enlarged liver	16%	17%	20%	5%	9%	19%
Infective eye problems	12%	43%	4%	5%	14%	12%
Skin diseases	20%	7%	20%	0%	0%	0%
Joint problems	28%	17%	16%	5%	9%	19%
Tuber-culosis	4%	0%	4%	0%	14%	8%
Bronchial asthma	0%	10%	0%	0%	5%	4%

Table 4.3 Results regarding health from clinical examinations

From the clinical examinations it also became apparent that the health of municipal garbage workers is better than that of the other groups. If dump site waste pickers are compared to the street pickers the street pickers suffer more from enlarged liver and they suffer to the same extent from angular stomatitis and tuberculosis as the dump site waste pickers.

No explanations are given for the differences found between the groups.

Water quality of the tubewells:

Water samples were taken from the tubewells and were tested for physical, chemical and bacteriological parameters.

Water quality of the open wells:

* The quality of the water from the open wells was very poor. Heavy metal concentrations were within the permissible limit but alkalinity (among others) was high.

Water quality of the pond water:

* The ponds were contaminated with heavy metals and all the water samples from the ponds showed very high faecal coliforms.

Explanations for the findings were not given. It is remarkable that in this study the health of the municipal garbage workers is generally better than that of the other groups.

4.2. Reactions from the resource persons

This paragraph contains the reactions of the resource persons that were interviewed in India on the subject of occupational health related to waste collection and recycling. The occupational health risks are subdivided into occupational health risks related to waste collection by waste pickers, waste collection by municipal garbage workers and the recycling of waste materials.

4.2.1. Waste collection by waste pickers

As was also concluded in the first Working Document on occupational health aspects of waste collection and recycling, some of the resource persons, in particular the ones with a background in occupational health, mention the methodological problems in relating a disease to the occupation of waste picking. The biggest problem according to the resource persons is selecting a suitable control group.

All the resource persons shared the opinion that waste collection and recycling pose dangers to health. But on the other hand they agreed that you have to look at it from the Indian context because it is a very important source of income for many of the urban poor. One resource person said that a while ago in India the opinion of the government was that waste picking should be banned. The authorities did not like the sight of people picking garbage in the streets, and in New Delhi plans were made to forbid it. The argument was used that it was too dangerous for the waste pickers and also for the general public, because the waste is taken out of the dustbins and the part that is not taken by the waste pickers is left out on the streets. Therefore street pickers were banned from the streets of New Delhi, but that did not solve the problem. Waste pickers kept on coming back and after a while the ban was stopped. Slowly the opinion towards waste pickers and waste related activities is changing. The general public is becoming aware that people are driven to waste picking out of poverty and that waste picking will only stop when there is an alternative.

Apart from the illnesses that are quite common among waste pickers (which are listed in Working Document 4 - Part I), many resource persons mentioned the risks that waste pickers run by getting into contact with hospital waste. Because hospital waste is not separated from the waste stream, waste pickers as well as municipal garbage workers are exposed to it. And although no research has been undertaken into which diseases can be transmitted, it is clear to many of the resource persons that it is dangerous.

One of the experts mentioned the risks of lung diseases caused by the smoke from dustbins that are set afire in the evening. This poses dangers to waste pickers because when they start picking waste early in the morning, the garbage is still smoking.

That the waste pickers are seen and treated as 'social outcasts' is described by a waste picker in Bangalore. When he was asked if he was ever bitten by rats or dogs he responded that he had even 'been bitten by men', animal bites were not the biggest problems he faced.

Another danger waste pickers working on waste dumps are exposed to, according to one of the resource persons, is related to the living environment. They live near (or on) the dump site, where the environment is very polluted. Another resource person has done research among waste pickers working on the dump site of Calcutta, Dhapa and has compared their health to street pickers in the streets of Calcutta. He came to the conclusion that the health of the dump site pickers was slightly better than the health of the street pickers because in Calcutta most of the pickers on Dhapa live in the nearby villages. They have a place to return to after work and they belong to a community. Most of the street pickers though sleep on the streets, do not have a place to clean themselves and cook, and many of them live a disrupted social life.

4.2.2. Waste collection by municipal garbage workers

Many resource persons mentioned that more attention should be paid to municipal garbage workers. The risks they face can be compared to waste pickers because, as one person mentioned, "waste is not collected in a scientific manner". The differences in comparison with waste pickers are that municipal garbage workers are organized, have a legal job, sometimes are provided with houses and schooling for their children and insurance schemes. On the other hand, they are equally exposed to mixed wastes like waste pickers. And although some of them are offered personal protective equipment like gloves and boots, in practice they do not use them. Like waste pickers, municipal garbage workers belong to the lower socio-economic strata of society.

4.2.3. Waste recycling

The occupational health risks in recycling enterprises depend on the material being recycled. There is also a clear need for identifying the health hazards. No studies have been undertaken yet. Some of the persons interviewed had the opinion that there are many health hazards in plastic recycling enterprises because of the outdated technology used and of the toxic fumes being released.

The major problem according to all the resource persons is the fact that the majority of the persons involved in waste collection and recycling are unaware of the occupational hazards. Many are also unaware of personal hygiene.

A case-study in India

Part of a study into the recycling sector in Bangalore (by van Eerd, 1995) looked at working conditions in glass-cullet wholesale enterprises (see also the photos on the next pages). In these enterprises the majority of the labourers are women and children and the division of labour is strongly gender-related. The men are engaged in the loading and unloading of the cullets, the women and children do the sorting.

1. Occupational accidents.
   Because the work place is packed with glass cullets, which are not separated from the workers, there is a great risk of falling into the glass. The labourers often incur cuts. Women and children sort the cullets with their bare hands.
2. Physical risks
   In cullet wholesale enterprises the workers mostly work outside and they complain to suffer from headaches, because during the warm period the sun gives a lot of reflection through the glass-cullets. During the rainy season they suffer from colds
3. Chemical risks.
   The extent of chemical risks depends on the chemical substances that can be found among the cullets. In the enterprises included in the research also medical bottles were recycled. The bottles gathered were emptied on the floor of the workplace
4. Ergonomic risks
   Ergonomic risks are highly dependent on the job performed. The female labourers suffered from back-aches because they sit on the ground in one position for several hours. The men suffered from back-aches and body-aches because of the heavy carrying the whole day.
5. Psychological risks
   In glass-cullet enterprises work is sometimes organized on piece rate which can cause stress to the labourers. Another factor is that working with waste is looked down upon. This is even more the case for female workers, because 'respectable women' do not work.
6. Biological risks.
   Biological risks are caused by the dirt and dust in the workplace.
7. Others.
   Not applicable.

The risks the case-studies focused on were mainly caused by biological agents, and some by chemical factors, physical factors and accidental accidents. Hardly none of the studies mentioned the ergonomic risks and only one study mentioned psychological factors that may play a role in working with waste.

5.2. Methods to assess working conditions and environmental pollution

Not much information has been found on methods for assessing waste related working conditions. General strategies for improving working conditions have been developed by Boleij *et al.*, the ILO and PRIA. Only van der Meer (WASTE) has applied general strategies to working with waste. It seems very useful that these strategies are tested out in waste collection and recycling activities. Information on participatory methods for assessing environmental pollution has not been obtained

5.3. Strategies to improve the working environment and reduce environmental pollution

In the literature on working conditions and occupational health aspects of waste collection and recycling four different points of view are predominating, namely

1. The point of view that the dangers of the work are relative and that waste picking is an income providing occupation that is essential to many of the poor in economically less developed countries. They claim that many waste pickers are better of than people living in the same slum who are without a job, because they at least have an income.
2. The point of view that working with waste is unhuman, and should be abolished as soon as possible
3. The point of view that before valuing the work more research on the occupational health aspects of working with waste should be undertaken.
4. The point of view that waste forms a source of income, which is essential for many poor people and that low-cost measures to improve the working conditions are necessary and possible.

The last point of view (no. 4) can be elaborated for each waste activity, with the use of the 'four level strategy' (see Paragraph 2.6.2). Taking the cullet wholesale enterprises (see also Box 5.1) as an example, the four level strategy for each occupational risk mentioned in Paragraph 5.1 is listed in Box 5.2[25].

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[25] The aim is not to elaborate a complete strategy, but to illustrate possible strategies by means of an example. Also, it is obvious suggested improvements should be tested in the field.

5.4. Recommendations for follow-up activities

The recommendations that are mentioned below are based on the information gathered through this desktop study. They are formulated for WASTE to be integrated in the Urban Waste Expertise Programme (UWEP).

A. Short-term recommendations:

- Literature research and interviews with resource persons in India.

A lot of information on the topic comes from India. Also a lot of the responses on the questionnaire came from organisations and persons active in the field of occupational health and waste collection and recycling in India. It is assumed that more information is available in libraries in India, e.g. from the Centre for Science and Technology (CSE) in New Delhi. It is therefore recommended to do a similar literature study in India. While doing the literature study it is suggested to interview resource persons active in the field of occupational health, e g from PRIA in New Delhi and FOCUS in Calcutta, in order to obtain an idea of the different points of view on possible improvements, and existing knowledge

B. Medium-term recommendations:

- Workshop

It is recommended to organise an international workshop (e.g. in India) for key persons to

1. Exchange expertise on the subject
2. Identify major issues and problems
3. Formulate strategies
4. Discuss possibilities for cooperation between the different participants of the workshop on the subject

- Field studies to assess working conditions

For field studies it is advised to use the list of occupational risks as formulated in Paragraph 5.1, and the four level strategy as formulated in Paragraph 2.6.2. The aim of the study is to make an inventory of all risks that are present in the working place, and to formulate strategies for improving the working conditions.

C. Long-term recommendations

Based on the field studies, the literature study in India, the interviews with key persons and the international workshop long-term recommendations can be formulated. At this moment it is already possible to conclude that:

- Financial and technical assistance is necessary, in particular for small-scale waste entrepreneurs, individuals as well as enterprises, that thrive in difficult economic circumstances and have limited financial returns.

- Awareness raising on the risks present in the working place both for employers as employees, and on possible changes they themselves can introduce to reduce these resources.

INDIA'S GOVERNMENT POLICY ON OCCUPATIONAL HEALTH

This chapter deals with the legislation on occupational health in India. It describes the government policy in general and the municipal policy in Calcutta[3].

Furthermore, this chapter describes laws designed for factories, an insurance and compensation scheme and legislation on the amount of chemicals that is accepted in the air of a workplace. Reactions from resource persons are also included.

2.1. Government policies on urban solid waste management

2.1.1. National policies[4]

The Planning Commission of the government of India is a body of the National Government that defines policies for the country as a whole[5]. Regarding the future of solid waste management, the Planning Commission has elaborated a policy document on solid waste management which includes some interesting remarks on waste collection and recycling[6].

At the national level the Ministry of Urban Development is the responsible agency for solid waste management. It deals mostly with general issues such as training programmes. Other ministries have more specific tasks. For instance the Ministry of Forestry and Environment has established a task force to review plastic recycling industries and formulate guidelines. It has also formulated guidelines for the storage and disposal of hospital waste. The Central Pollution Control Board is another central agency which has formulated guidelines for hazardous (industrial) waste and is also responsible for the enforcement of those guidelines.

At state level solid waste management comes under the responsibility of the Municipal Affairs Department.

Traditionally the municipality is the responsible body for solid waste management. The major cities have separate departments for solid waste management. For instance in Delhi the Conservation and Sanitation Department is responsible for street sweeping, collection, transportation and disposal of garbage and the Engineering Department is responsible for the technical and physical support such as the provision and maintenance of vehicles and dustbins. In other metros, e.g. Calcutta and Bangalore, the departments responsible for solid

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[3] It was decided to choose the municipal policy in Calcutta to write about and not the ones of New Delhi and Bangalore for two reasons. The first reason is that only in Calcutta conversations on municipal policy were held with resource persons from municipality. The second reason is because in Calcutta the policy on waste management has changed drastically over the last few years.

[4] This paragraph is based on communication with Christine Furedy, Esha Shah and Shuchi Gupta.

[5] The Commission is autonomous, constituted by the government of India and is not related to any ministry.

[6] In: Planning Commission Government of India, 1995.

waste management are the Health Department, responsible for the safe collection and disposal of solid waste, and the Engineering Department, responsible for the physical and technical support. However, most municipalities lack a specific department responsible for solid waste management and generally the Medical Health officer looks after it.

2.1.1.1. Waste collection

The Committee recommends that the segregation at source of inorganic recyclable materials such as plastics, glass, metals and papers should be promoted. Households should therefore be stimulated to separate their waste for which they will be provided with containers. Every day the waste materials should be collected from the households and transported to the dump site in which private agencies, NGOs and waste pickers or their cooperatives could be involved.

It is worth noticing that in the report of the High Power Committee the role of waste pickers is acknowledged to be an important one. It is recommended to set up cooperatives for waste pickers in the cities so that the middlemen are eliminated and the waste pickers get due financial reward for their work. According to the Committee, such a cooperative could also provide facilities for improved hygiene such as community toilets, baths, conducts programmes for non-formal education and vocational training for the waste pickers. Furthermore, cooperatives would give waste pickers the recognition that they are an essential link in urban solid waste collection and the recycling system.

The segregation of waste at the household level, according to the Committee, is the most important solution to the problem of health hazards of waste pickers. They formulate the role of waste pickers in the system of waste collection as assisting the population by collecting all the properly segregated waste. Attempts may also be made to ensure that they wear some affordable protective gear such as plastic gloves and footwear.

2.1.1.2. Waste recycling

Industries engaged in processing the recyclable waste materials such as paper, plastics, glass and metal should be given financial assistance to upgrade their technology so that the products are of better quality, cost of production is less and marketability of the product improves. According to the Committee it is necessary to assess the state of art of the present technologies used for recycling garbage, and undertake research, development and pilot-scale studies to develop new technologies and upgrade the existing ones. A legislative framework has to be supplemented to sustain successful solid waste management.

Appropriate efforts should be directed to improve the awareness of the industrial management, health care personnel and general public of their respective roles in ensuring safe disposal of potentially hazardous waste material.

Furthermore, waste recycling is to be encouraged and strengthened because the salvaged material is free of any material cost, except for the cost of collection.

2.1.2. Municipal policy in Calcutta on solid waste management

In the last two years the municipal policy in Calcutta regarding solid waste management has drastically changed according to the two resource persons of the Calcutta municipality.

Previously the garbage was piling up in the streets. The sweepers could not keep the city clean because waste was dropped on the streets irregularly by households and shops. Besides waste was not collected adequately by the municipality and many streets were not cleaned at all.

After the outburst of the plague in Surat in 1994 people became aware that waste management in urban areas had to be improved. In Calcutta the municipality decided that the attitude of the public regarding waste disposal had to change. The public was reached by newspapers, television and pamphlets. They were told to put their waste in a plastic bag which would be collected by a sweeper in the morning. The sweepers were trained to approach the public very politely. They were given gloves, a handcart and a whistle to announce they entered the street. In the slum areas, where the trucks cannot enter, the municipality put containers at the entrance, in which the sweepers dump the garbage. After 12 a.m. it was no longer allowed to put waste into the dustbins. Also, private companies were hired to assist the municipality in the collection of waste. Besides, garbage from restaurants, hotels and hospitals is taken to the dump site at night. According to the two resource persons the result is that nowadays the city is much cleaner.

Regarding the safety of the municipal garbage workers, each year gloves and shoes are handed out to them, and every fourth year they are given a rain coat. Also, municipal garbage workers live in special quarters provided to them by the municipality, schooling is offered to their children, they are ensured by group insurance and they get a fixed government salary. According to one of the resource persons of the Calcutta municipality the municipal garbage workers in general had no health complaints because 'they were immune by nature'. Furthermore, they could go on leave whenever they feel like it (in case they feel bored or want to visit family they can take unpaid days off).

The priorities of the Calcutta municipality regarding the handling of waste are:

1. There should be no open collection points of waste in the streets.
2. Solid waste should not be handled twice, so in the future waste will be transported to the dump site directly from the households.
3. Nobody should come in direct contact with solid waste.

To improve the cleaning of the streets the municipality is planning to introduce mechanical sweepers.

2.2. Legislation on occupational health

In India, the legislation that regulates the safety of the work environment and occupational hazards can be divided into three categories:

1. Perspective-protective acts
2. A curative act
3. A compensatory act

2.2.1. Perspective-protective acts: the factories act

The perspective-protective acts are preventive health laws, as there are: The Factories Act (1948), The Mines Act (1952), The Plantation Labour Act (1948) and The Beedi and Cigar Workers Act (1966). These acts prescribe specific standards for working conditions in factories, mines, plantations and beedi and cigar manufacturing industries. Only the Factories Act is being explained in more detail because of its possible applicability to recycling enterprises.

The Factories Act has laid down provisions for the general health of workers by prescribing details about cleanliness, disposal of waste and effluents, ventilation and temperature, dust and fumes, artificial humification, overcrowding, lighting, drinking water, latrines, urinals and spittoons. It provides for the safety of the employees in prescribing rules on, among others, the fencing of machinery, employment of young persons at dangerous machines, striking gear and devices for cutting power supply, lifts, chains, ropes, revolving machines and any hazardous operation. It also discusses the protection of eyes, protection against fumes, explosives and inflammable gas and precautions against fire. Also safety specifications for building and machinery are mentioned in the Act (Jaitli et al., 1996, p. 11).

The Factories Act is applicable to enterprises that fall within the following criteria:

1. A manufacturing process is being carried out.
2. The manufacturing process must be such as to employ ten persons with the use of power or twenty persons without the use of power.
3. The workmen must be employed as part of the manufacturing process.

Factories that are not covered by the act are legally exempted from any kind of safety standards, inspection or minimal working conditions (D'Souza, 1995, p. 11).

After the Bhopal tragedy in 1984, the Factories Act was amended to include an entire chapter on hazardous processes and safety issues specific to the chemical and related industries. These amendments also give certain rights to the workers and the citizens living in the vicinity of the industry (Jaitli et al., 1996, p. 12).

The Chief Inspector of Factories has the highest authority to inspect and recommend safety and health measures. Any bodily injury or accident occurring in a factory which results in the absence from work for 48 hours of the injured worker has to be reported to the Factory Inspector's Office.

In the Model Rules under the Factory (amendment) Act 1987 (National Safety Council, p. 62) it is mentioned that the qualification needed to become a Factory Supervisor in factories working with hazardous substances is a degree in Chemistry, Chemical Engineering or Technology. The Chief Inspector may require the supervisor to undergo training in Health and Safety. Thus a supervisor is not necessarily an occupational health specialist.

2.2.2. A Curative Act: the Employees State Insurance Act

The Employees State Insurance Act can be used by the worker in case of an occupational disease or accident.

The Employees State Insurance Act (ESI) was enacted to provide a comprehensive health insurance scheme to workers. It seeks to provide a multi-dimensional social security cover to the ensured persons. The services include:

1. Medical care
2. Sickness benefits
3. Maternity benefits
4. Disablements benefits
5. Dependents benefits
6. Funeral expenses
7. Rehabilitation allowances
8. Vocational rehabilitation training

The Employees State Insurance Act does not apply to seasonal establishments. Furthermore, the act is applicable in the first place to 'factories' as defined under the Factories Act, so workers in small factories, are not covered by any health insurance. Also workers earning more than Rs.3000 a month are not covered by this act (D'Souza, 1995, pp. 10-11).

For workers who can ensure themselves under the Employees State Insurance Act, and who pay their monthly contribution, it is still very difficult to get the required treatment. There are special ESI hospitals where workers can go in case of an occupational disease, but these hospitals lack equipment and medical supplies. Nor is there enough knowledge among the medical staff on occupational diseases. For instance in cases of respiratory diseases, these are often confused with tuberculosis and in such instances the worker cannot receive compensation because this is not a compensable disease[7]. Furthermore, workers who try to get treatment and compensation for occupational diseases are often not welcomed at the ESI hospitals.

2.2.3. A Compensatory Act: the Workmen's Compensation Act

The Workmen's Compensation Act is the basic legislation dealing with compensation to workers in cases of industrial accidents and occupational diseases.

The act excludes casual workers. Having a regular stable job becomes a precondition for payment of compensation to workers in case of industrial accidents. Taking out casual employment from the application of this act, not only excludes people from the benefits of compensation, it also encourages the informalisation of work within industry, thus creating a cycle of the informalised work and denial of compensation (D'Souza, 1995, p. 8). Furthermore, the compensation is only applicable to the 33 occupations named in the act. Since the act was designed in 1923 newly created jobs are not covered by it. Another shortcoming of the act is that for workers earning more than Rs.1000 per month, the compensation is not more than Rs.1000 a month (D'Souza, 1995, pp. 8-10).

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[7] The compensable diseases are listed in the ESI Act, examples are: diseases caused by lead or its toxic compounds, diseases caused by mercury or its toxic compounds and diseases caused by chromium or its toxic compounds.

2.3. Threshold Limit Values (TLVs)[8]

Threshold Limit Values refer to the concentration of chemicals in the air. Workers are exposed to a certain amount of chemicals every day. There is an average limit to which workers can be exposed without being affected. Three types of TLVs are being used in India. TLVs are expressed in parts per million (ppm) or milligrams per cubic metre of air (mg/cu.m)[9].

Three types of TLVs are being used in India[10]:

1. The TLV-TWA is the Time Weighted Average to which a worker is allowed to be exposed in the workplace.
2. The TLV-STEL (Short Term Exposure Limit) shows the amount of chemicals one can safely breathe in a span of fifteen minutes.
3. The TLV-C (Ceiling value) gives the upper limit of exposure to a given chemical at any given point of time. This limit should never be crossed at any time. The TLV-C is not prescribed for all chemicals.

2.3.1. Shortcomings of the TLVs

Although the TLVs are relevant indicators, they are in itself a compromise. The TLVs are based on:

1. Normal conditions
2. An average healthy worker
3. Effects of a single chemical

The general shortcomings of TLVs are:

1. High temperature, humidity and noise are not uncommon and TLVs are not given for such conditions. This should be adapted because for instance heat and high noise can reduce the capability to resist chemicals.
2. Another problem is that to measure the amount of chemicals in the air the management has to install metres, which very few will do on their own account. The labourers have to put pressure on the management to install equipment, or to contact the Factory Inspector.

The TLVs are American parameters which have not been adapted to the Indian situation. Shortcomings related to that are:

1. The effect of a chemical depends upon the body weight of the person. The average body weight of an Indian worker is less than the average weight of an American worker. So the TLVs developed by western agencies for western workers should be

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[8] Information is based on: Pandey and Kanhere (1993), PRIA (1989) and interviews with resource persons.

[9] PPM refers to the number of chemical parts per million parts of air. This is a limit given in terms of the volume of the chemical in the air. The mg/cu.m. value is a straightforward concentration in terms of weight.

[10] The permissible levels of 117 chemicals are listed in Pandey and Kanhere, 1993, pp. 89-93. They are subdivided into a Time Weighted Average (LV-TWA), a Short Term Exposure Limit (TLV-STEL) and a Ceiling Value (TLV-C).

proportionately reduced for Indian workers. And TLVs have been based on the assumption of a normal healthy worker. In the Indian situation many workers are malnourished. Furthermore, in some instances they have already been exposed to dangerous chemicals and pollutants for years, so they cannot withstand even far less amounts of chemicals than the ones prescribed in the TLVs.

2. The TLV-TWA are based on a working week of 40 hours. In many of the Indian enterprises the working week is 48 hours. So the TLV-TWA should be adapted to the Indian situation, which means reducing it proportionally.

2.4. Reactions from resource persons

The problem with small-scale enterprises (with a maximum of 10 workers with the use of power and 20 workers without the use of power) is that they are not covered by the Factories Act. Furthermore, many of the small-scale enterprises are illegal or semi-legal. In order to get rid of the health hazards in those enterprises according to some of the resource persons, the implementation of laws is very important. But because of the illegal or semi-legal character of these enterprises, the enterprises are also difficult to check. In order to implement laws also more information on dangers in the workplace is needed.

To stimulate employers to improve the working conditions, it is very important to make them aware and show them that by improving the working conditions the productivity will increase. To cover these enterprises by legislation you should provide them with positive incentives, such as the exclusion from paying tax (otherwise they will continue operating illegally).

Another aspect in improving working conditions in small-scale enterprises is that labour unions have to become more interested in occupational health. One reason for the lack of interest from the part of the unions, is the high level of unemployment in Indian society. Most of the struggles of the Indian trade union movement still revolve around securing employment. Labour unions should adapt their policy, they should not only be fighting for the quantity of jobs, but also for the quality of those jobs.

STRATEGIES TO IMPROVE WORKING CONDITIONS IN WASTE COLLECTION AND RECYCLING

This chapter gives an overview of the literature and information gathered through interviewing resource persons in India on the possibilities and experiences of improving working conditions in the collection and recycling of waste materials.

5.1. Strategies to improve the working conditions of waste pickers

From government side no initiatives have been undertaken to improve the working conditions of waste pickers. Only some NGOs are involved in projects with waste pickers.

To improve the working conditions of waste pickers, NGOs are involved either in:

A. Improving the actual working conditions
B. Looking for alternative employment

5.1.1. Suggestions to improve the actual working conditions

To improve the actual working conditions of waste pickers, many of the resource persons mentioned that waste pickers should be made aware of the risks related to their occupation. Furthermore, they were of the opinion that waste pickers should be trained in personal hygiene. One resource person mentioned that waste pickers need washing facilities and a place to change clothes. Also, according to some resource persons, they should be offered protective devices. Resource persons with experience in the field, especially those working in NGOs with waste pickers, said that this is not a solution. According to them waste pickers will not wear protective devices. The use of gloves delays the sorting process, "waste pickers want to have direct contact with the waste they pick", and boots are too hot, especially in the summer. Masks are also not very useful, although a lot of waste pickers at Dhapa (dump site of Calcutta) wear improvised cotton masks (shawl) in the summertime, because otherwise the smell is unbearable.

An option to improve the working conditions is that waste pickers should organize themselves in cooperatives. This would lead to more bargaining power on prices for collected recyclables with dealers and wholesalers.

A very well known cooperative is the cooperative of paper pickers, SEWA (Self Employed Women's Association), in Ahmedabad. SEWA is a registered trade union which started its work with women in the informal sector in the early 70's. Over the past 20 years it has organized self-employed women in order to help them enter the mainstream economy. Approximately 2000 female waste pickers are organized through their cooperatives. As a short measure SEWA has designed equipment for the pickers to prevent them handling waste directly. SEWA's pickers are given a license to prevent the police from harassing them; routine health check ups are done. In addition the SEWA members can make use of the cooperative bank and housing schemes. Waste paper, collected by the members is being sold to a wholesaler, who has set up a shop and sells the material to a trader. Although, according to Ramaneshwari (1994, p. 34-37) SEWA has not managed to increase the income of the

waste pickers involved, it has succeeded to develop the women's self esteem, confidence and courage to fight against the exploitative forces in society.

5.1.2. Alternative solutions

An alternative solution to improve the working condition for waste pickers is to introduce projects of separation at source. Households should be stimulated to separate their waste, which will be collected by former waste pickers. Projects are set up, among others, by SRISHTI in New Delhi (see Box 5.1). FOCUS in Calcutta, and CEE and Waste Wise in Bangalore have set up similar projects where former waste pickers are involved in a system of door-to-door collection of waste. The households separate the waste into organic and inorganic materials. The inorganic materials are sold by the former waste pickers to junk dealers. In some projects the organic materials are being used for the production of compost.

Aimed at stopping open dumping of garbage with the ultimate goal of achieving waste reduction through processing, a programme set up by SRISHTI is based on community participation with door-to-door collection of waste, which is partially segregated. Residents are asked to segregate glass, metal and any other items that may be dangerous to those handling the waste. Residents pay a certain amount of money a month for the door to door collection.

The door-to-door collections are carried out by former waste pickers. They are paid a fixed salary, paid by the residents, and besides that they earn an extra amount of money by selling the collected recyclables. The social impact of the project is significant. The advantages for waste pickers working in the scheme is that they have obtained secure employment and an identity card. A formal job also reduces the harassment by the police. This contributes enormously to the confidence and self respect of these former waste pickers.

In order to reduce the health risks of waste collection the waste pickers are offered slippers and gloves, but they do not wear them, especially not in the summer because it is too hot. But because the waste is already partially segregated by the households, the risks of cuts and infections are reduced.

The project is self-sufficient. The households pay a certain amount of money for the collection, of which the waste pickers are paid. The initial mobilisation was carried out by one or more civilians within the colony where door to door collection was started, with the support of the SRISHTI staff. After the programme was set up, SRISHTI left the responsibility of the project to the colony.

(Venkateswaran, 1996).

Box 5.1. Community based door-to-door collection of solid waste, initiated by SRISHTI, New Delhi.

5.2. Strategies to improve working conditions for municipal garbage workers

When resource persons of the municipality, responsible for municipal solid waste management, were asked about the working conditions of their employees they answered that municipal garbage workers are offered protective devices such as gloves, boots and rain coats. "But," they said, "in practice these workers do not wear them." According to them this was beyond their responsibility.

To improve the working conditions for sweepers, one of the resource persons of the municipality in Calcutta said that there are plans to introduce mechanical sweepers. However, it is doubtful this is a solution since mechanization usually leads to unemployment.

5.3. Strategies to improve working conditions in recycling enterprises

Although there are no experiences with improving working conditions in recycling enterprises in India, there was a general consensus among the resource persons that there is a need for improvements and that there are possibilities for those improvements.

Options mentioned are:

1. The technology used in the enterprises should be upgraded.
2. Studies should be executed to identify the hazardous materials that are being recycled, for instance PVC.
3. Health hazards have to be identified more properly.
4. Zones of recycling enterprises could be developed at the border of the city. Entrepreneurs could then make use of common facilities such as infrastructure, water and sewage systems.
5. Recycling entrepreneurs could set up a fund to finance improvements in the recycling sector.

At the policy level financial incentives could be developed to give support to enterprises that work in an occupational and environmentally sound way, e.g. excluding them from the obligation to pay taxes for a certain number of years.

The opinions differ on the question who should be the initiator of those improvements. Some said that the government should take the first step in developing legislation and guidelines on working conditions in small-scale enterprises. According to others, NGOs should take the initiative and should be the driving force in improving working conditions in small-scale enterprises because there is already enough legislation, but implementation is not taken care of.

One resource person, working at government policy level, was very negative on achieving improvement through government action. According to him government is just not interested in working conditions in small-scale enterprises. But when the public opinion changes and NGO initiatives are proven to be successful the government will (have to) follow.

Pilot projects could be started in small-scale enterprises to improve working conditions. To make it attractive for employers to cooperate they have to be financially risk free and offered

positive incentives such as free training in business administration for cooperating in these projects. The projects have to show that by improving working conditions productivity will increase, so that other employers will follow this example.

Some said the workers should be obliged to wear protective devices, which others, especially those working in the field of occupational health were strongly opposed to. According to them the responsibility for the safety in a workplace should be for the management. Otherwise, if labourers are given devices, which in most cases they do not use, the employer can blame them if they get ill for not using the protective equipment.

None of the resource persons is familiar with improvements in small-scale enterprises.

THE ROLE OF COMMUNITY MEMBERS AND LOCAL LEADERS IN COMMUNITY-BASED SOLID WASTE MANAGEMENT

1.1. The role of community members: from behaving well to decision-making

Community members and local leaders in urban communities play different roles in solid waste management. These roles correspond to different levels of community participation as derived from the water literature and adjusted for solid waste management. Community members can participate in solid waste management by showing proper sanitation behaviour, by contributions in cash, kind or labour, by participation in consultation and by participation in administration and management of solid waste services.

Proper sanitation behaviour is behaviour that facilitates solid waste management systems. It may include:

* Adapt daily habits to agreed solid waste system (rules, schedules, e.g. to offer it at the right time and place to the collection team)
* Bring garbage to communal collection point for transfer
* Store garbage in a plastic bag, a special bin etc.
* Cooperate in clean-up campaigns
* Keep house and immediate environment clean (drains. streets in front of the house)
* Separate waste in organic and non-organic, wet and dry, keep plastic, paper etc. apart
* Compost the organic fraction in own backyard

Some projects try to influence and change the sanitation behaviour of households via education, awareness campaigns, etc. The effectiveness of these campaigns depends on the influence of the persons who carry out education and on the degree of social control within a neighbourhood.

Contributions in cash, kind or labour are more direct contributions to the operation of solid waste management projects. They usually involve:

* Regular fee payment for collection
* Donate or lend equipment to the collection team
* Contribute in labour with collection (voluntary or paid)

Money is needed to cover capital costs (to buy or rent equipment) and to cover daily expenses through collection fees. These fees sometimes cover both primary and secondary collection, but mostly community-based solid waste management projects are only involved in fees for primary collection. The ways of payment differ. Contributions in kind are less common; they include the grant of local materials and equipment by neighbourhood residents. Labour inputs, on the contrary, are more current: voluntary contributions like helping with construction and arrangement of

disposal sites, or with loading garbage in municipal vehicles. But salaried employment in the operation of a collection scheme, in a sorting and recycling centre or at a composting plant, is more common.

Participation in consultation may take place during a needs assessment study or some other form of preliminary research, such as home visits and meetings organized by CBOs to talk about the needs and problems regarding solid waste management. It may include:

* Answer preparatory research questions
* Attend meetings
* Elect leaders, representatives who manage waste collection
* Elect members of micro-enterprises
* Give feedback about collection system/waste services to operating team or management

Consultation may concern only the representatives of the community, or all sections of the community. This last option also includes minorities and disadvantaged groups such as youths, women, etc. The way of consultation determines the outcome, that is whose needs are assessed, who will be the beneficiaries, etc. In solid waste management projects that require changes in behaviour, such as cleaning, separation at source, recycling, and composting, preliminary studies are especially useful.

Participation in administration and management is the highest level of community participation in solid waste management. To this end, community members may:

* Take part in committees
* Become member of a CBO involved in waste collection, environmental education, etc.
* Participate in decision-making during meetings

Real community management, involving all three aspects of responsibility, authority and control, as mentioned in the Introduction, is not very common in solid waste management. Using one criterium, control by a neighbourhood committee, one can conclude that one third to half of the solid waste management projects studied are managed by the community. Only a small segment of the community is really active in the management of a garbage collection scheme, a recycling centre or a composting plant. Their tasks will be described in the next paragraph.

1.2. The role of local leaders: intermediaries between communities and municipalities

Local leaders can be divided into traditional, formal and informal leaders. Traditional leaders derive their authority from hereditary rights and from their status in the local culture. Formal leaders are appointed by the government or elected as local representatives of the government. Informal leaders are influential members of a

community on the basis of their personal status or of their activities in community-based organizations such as political parties, churches, youth and women's organizations, neighbourhood committees, etc. All three types of local leaders may have different roles in solid waste management. Usually formal and informal leaders are more involved in solid waste management than traditional leaders. Involvement in management of solid waste services includes participation in the management of solid waste services and keeping in contact both with the municipality and the community.

Management of solid waste services can be carried out by existing community-based organizations or by new committees particularly established for this purpose. Members of CBOs may also participate in the management committee of a solid waste service. The tasks of this management committee can be defined as follows:

* Performance control of services
* Administration of activities
* Engage personnel for operation
* Manage fee collection
* Keep treasury
* Decision-making on operation

The management committee has the responsibility for the administration of activities, monitoring the work flow, managing manpower and means, and matching the objectives with the means. It has decision-making power and controls the operation of the service. The community member or members who were responsible for taking the initiative, are often involved in management. But an NGO or governmental agency starting a solid waste management project, may also ask community members to be engaged in the management committee. A local leader such as the president of a community-based organization, can also exercise supervision on a higher level, controlling the management committee.

Keeping in contact with the municipality may take different forms:

* Communicate about the coordination of primary and secondary collection systems
* Exercise political pressure on the municipality
* Forward complaints about performance service

A community-based organization may contact the responsible municipal agency to integrate primary and secondary collection. When no service is delivered to the area, or when certain equipment is needed, it can exercise political pressure on the municipality, the mayor, etc. Complaints on the secondary collection from households can be forwarded jointly by them to the municipality, or to the management committee when the complaints concern the primary collection system.

Regarding **contacts with the community**, local leaders may:

* Carry out education and awareness raising
* Control of behaviour households (watchdog function)

* Mobilise the community

A community-based organization may design and implement education campaigns, even if it is not directly involved in waste collection or treatment. Thus it can support collection services and change the behaviour of households. It may also have a watchdog function, to control that the behaviour of households conforms to the agreed rules and schedules. Traditional leaders are often involved in the mobilisation of the community for clean-up campaigns.

1.3. Women and youths: special roles in community-based solid waste management

1.3.1. Women

Women's cooperation is essential for the long-term success of any project concerning urban services. In many cultures, women are responsible for keeping the home and its immediate environment clean. So disposal of waste is one of their daily tasks. Furthermore, women are the first and foremost users of urban services such as water supply, sanitation, waste collection. This role of women makes them ideal beneficiaries of solid waste management projects. They usually give improvement of services a higher priority than men. But their voice is seldom heard and their participation in community decision-making is minimal. But women may not only be interested in solid waste management projects as a provision of a service. Also its employment and income generating aspects may interest them. What experiences appear in the literature on community-based solid waste management projects? What is the role of women there? What are their specific problems?

Not all community-based solid waste management projects included in this survey, mention the involvement of women. However, 16 out of the 53 studied projects do. In these projects women play an essential part. Women's participation can take the following forms:

1. Women are often the initiators of a solid waste management project or of general improvement in solid waste management. Examples are famous women's associations such as the Women's Balikatan Movement in the Philippines, AS 19 and KAWWS in Pakistan, AS 17. In India the Women's Department of a university has developed a recycling project for women waste pickers (GRASP, AS 3).

2. They carry out education campaigns on sanitation behaviour, preventive health, environmental problems, etc. Examples are the Ivory Coast case (AF 6), Nepal (AS 16), MUPROBA in Peru (LA 15). Sometimes operation of a waste collection scheme is combined with education as is the case in Mali (COFESFA, AF 10), Mexico, (LA 14), Nepal (WEPCO, AS 15).

3. They are sometimes involved in the management of the system. In Indonesia (AS 13) the system is run by the wife of the local administrative leader. In Mexico 90 % of women in the community are active in the SIRDO recycling systems. Most are run cooperatively by them (LA 13).

4. They operate and manage a solid waste service as members of a micro-enterprise. Micro-enterprises for waste collection, street sweeping, etc. are often dominated by women. This is known from Latin American countries such as Bolivia (LA 3), Costa Rica (LA 9), Peru and Colombia. COFESFA (Mali, AF 10) can be regarded as a women micro-enterprise too. In Ivory Coast (AF 8) young women are employed as collectors too, called 'amazones'.

5. They exercise political pressure on local governments. MUPROBA (Peru, LA 15) is a case in point, an organization that took action for the implementation of certain services in their neighbourhood. The Women's Balikatan Movement (the Philippines, AS 19) and KAWWS (Pakistan, AS 17) are also active in this field.

6. They act as watchdogs of the community. Examples are WEPCO (Nepal, AS 15) and KAWWS (Pakistan, AS 17) who control that households keep to agreed rules of behaviour.

Reported problems encountered by women in community-based solid waste services concentrate on under representation in management committees and work in operation that is physically heavy. In the Ivory Coast projects (AF 6, 7 and 8) it was a problem that fees are monthly and too high to be paid by women alone. Husbands do not always want to contribute.

1.3.2. Youths

In some cases, young people play a special part in solid waste management too. Children often help their mother with her daily tasks such as bringing waste to the communal collection point. Unemployed adolescents discover the income-generating potential of solid waste services. In seven out of 53 projects special roles of youths in solid waste management are mentioned. In Mali (AF 11) groups of unemployed young graduates operate micro-enterprises, called 'groupes d'intérêt économique'. In Indonesia (AS 8 and 9), a youth organization operates a waste collection scheme and is responsible for fee collection. In Ivory Coast (AF 8), youth groups are involved in management and environmental education. A special case is Curitiba, Brazil (LA 7), where a school exists for children making toys from waste materials. Waste Wise (India, AS 1), runs a project with waste picking children who are trained for regular door-to-door waste collection. In a large low-income neighbourhood in Nairobi, Kenya (AF 8), youths engaged in a sports league are active with their sports team in neighbourhood cleaning activities during the weekends. They can earn extra points in the sports league with these activities. One problem related with the involvement of

young people in community-based solid waste services is mentioned in various of the projects: the youths want a material reward for their participation or management efforts.

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